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National Aeronautics and Space Administration

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VOLUME 2 NUMBER 24

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

December 23, 1964

01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-32767* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
CONFERENCE ON NEW TECHNOLOGY
Washington, NASA, 1964 161 p refs Conf. held at Lewis Res. Center, Cleveland, 4–5 Jun. 1964
(NASA-SP-5015) GPO: $1.00

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9. INFORMATION SOURCES J. J. Modarelli p 145–150

N64-32816 Joint Publications Research Service, Washington, D.C.
CYBERNETICS AND ECONOMIC MANAGEMENT
Vladimir Kadlec 7 Oct. 1964 12 p Transl. into ENGLISH from Zivot Strany (Prague), no. 15, Aug. 1964 p 953–958 (JPRS 26773; TT-64-51030) OTS: $1.00

The distinct roles of the scientist-researcher and the economist in applying cybernetics to economic management are stressed. The task of the economist is primarily the correct and singular formulation of the initial conditions, the important constraints, the objective of the computations, and economic analysis of the computed results. The search for new mathematical models should be left to scientists and mathematicians because of the twin dangers of overestimating or underestimating the practical usefulness of the model in the management of the national economy. M.P.G.

N64-32941 Congress. House. Committee on Science and Astronautics
THE NASA-DOD RELATIONSHIP
Washington, GPO, 1964 100 p refs Rept. of the Subcomm. on NASA Oversight, 88th Congr., 2nd Sess.

This review of the existing relationship between the National Aeronautics and Space Administration and the Department of Defense is issued by the Subcommittee on National Aeronautics and Space Administration Oversight of the United States House of Representatives. The very substantial military participation in the National Aeronautics and Space Administration programs is pointed out. G.G.

N64-33232 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS. X: COST ESTIMATE
Paul Baran Aug. 1964 29 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3766-PR; AD-444836)

This is a feasibility and implementation study of equipment cost estimates for a proposed digital-data communications system that is based on a network configuration of 400 switching nodes, servicing 100 000 simultaneous users via 200 principal multiplexing stations, and is expandable to handle more than one million users. G.G.

N64-33342 Air Force Academy, Colo.
REFLECTIONS ON SPACE: ITS IMPLICATIONS FOR DOMESTIC AND INTERNATIONAL AFFAIRS
Oscar H. Rechtschaffen, ed. Jan. 1964 326 p refs
(AD-602915)

This book provides a broad factual basis for informed discussion on the many complex problems of outer space. It deals with the social, economic, political, and military aspects of space from a national as well as an international point of view. No attempt is made to grapple with the technological or scientific aspects of the subject, since the book is written for the college student and the interested layman. D.E.W.

N64-33371* National Aeronautics and Space Administration, Washington, D.C.
AMERICAN PROGRESS AND GOALS IN SPACE News Release

James E. Webb Available from the Scientific and Technical Information Division [1964] 18 p Presented at the Inventors' Congr. and Space Symp., Little Rock, Ark., 30 Oct. 1964

Major achievements and plans of the NASA space program are briefly discussed by James E. Webb. New scientific knowledge with wide application is stated to be produced rapidly, and technological advances are said to be tremendous in all areas as a result of the space program. The key roles of inventors and inventions in this program are emphasized, and the regional economic impact of the program is reviewed. D.E.W.

N64-33516 Congress. House. Committee on Science and Astronautics

GOVERNMENT AND SCIENCE: DISTRIBUTION OF FEDERAL RESEARCH FUNDS. INDIRECT COSTS RE FEDERAL GRANTS

Washington, GPO, 1964 895 p Hearings before the Subcomm. on Sci., Res., and Develop., 88th Congr., 2nd Sess., 5–7, 12, 14, 19–21, 26–28 May; 2–4 Jun. 1964

Testimony is recorded that was given in hearings before the Subcommittee on Science, Research, and Development. The hearings were initiated to supply some definitive answers to such questions as the necessary level of Federal support for basic research, the important scientific areas now being neglected, the status of science education in the U.S., and criteria needing Congressional consideration in the undertaking of big, new, expensive research programs. The immediate attention of the hearings was given to the geographical distribution of the Federal research dollar and to the proper indirect costs that should be allowed in connection with Federally sponsored basic research. D.E.W.

N64-33863 Congress. House. Committee on Science and Astronautics

UNITED STATES AERONAUTICS AND SPACE ACTIVITIES, 1963. MESSAGE FROM THE PRESIDENT OF THE UNITED STATES House Document No. 207

Lyndon B. Johnson 27 Jan. 1964 151 p A report to the 88th Congr., 2nd Session

Activities are summarized for 1963, and accomplishments and programs are described for each of these organizations: the National Aeronautics and Space Council, the National Aeronautics and Space Administration, the Department of Defense, the Atomic Energy Commission, the Department of State, the National Science Foundation, the Department of Commerce, the Space Science Board, the Smithsonian Astrophysical Observatory, the Federal Aviation Agency, the Federal Communications Commission, and the United States Information Agency. D.E.W.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-32814 Brown U., Providence, R.I. Div. of Engineering

SECOND-ORDER FORCES AND PRESSURE DISTRIBUTION ON THREE-DIMENSIONAL BODIES BY REVERSE-FLOW INTEGRAL METHOD

S. P. Sutera May 1964 41 p refs Prepared for Applied Physics Lab., Johns Hopkins U.

(Contract NOw-62-0604-C; Proj. Bumblebee)

(CR-12; AD-449752)

The general second-order reverse-flow relation has been applied to fusiform bodies and to combinations of fusiform bodies and quasi-cylindrical wings. The second-order drag of an isolated fusiform body can be expressed in terms of the first-order forward and reverse flow over the body, provided the angle of incidence is not too large. The innovation of a reverse-flow that is not simply antiparallel to the forward-flow at infinity is introduced and then used to derive separate integral statements on the three rectangular components of the second-order velocity perturbation on the surface of an isolated fusiform body. Two of these integral statements are inverted to yield information on the second-order surface pressure distribution. The inversions effected are valid for unrestricted incidence. Author

N64-32945* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

AERODYNAMIC EFFECTS OF ATMOSPHERIC COMPOSITION

N. L. Fox and R. B. Blaylock N.Y., AIAA [1964] 8 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964

(Contract NAS7-100)

(AIAA Paper-64-481) AIAA: $0.50 members; $1.00 nonmembers

Wind-tunnel tests have been made on a variety of typical entry body shapes, in mixtures of air and carbon dioxide, for the purpose of evaluating atmospheric composition effects on aerodynamic forces and flow fields. The data resulting from these tests show that the effect of a carbon dioxide admixture (at temperatures where dissociation and radiation are not significant) is relatively small, and is adequately treated by existing theoretical methods. In the postentry supersonic phases of vehicle trajectories, it follows that existing experimental data obtained from air tests are applicable to planetary atmospheres with relatively small theoretical corrections. Author

N64-33129 Army Materiel Command, Washington, D.C.

TRAJECTORIES, DIFFERENTIAL EFFECTS, AND DATA FOR PROJECTILES Engineering Design Handbook

Aug. 1963 57 p refs

(AMCP-706-140)

This pamphlet deals with the subject of exterior ballistics, covering trajectories, differential effects, and data for projectiles. The pamphlet pertains to that phase of projectile life starting at the gun muzzle (or, for a rocket, at burnout) and ending at the point of burst or impact. The subject is covered in a manner intended primarily to assist the ammunition designer in recognizing and dealing with the design parameters of projectile weight, shape, muzzle velocity, yaw, drag, and stability, in designing for optimum results in range, time of flight, and accuracy. Author

N64-33196* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

PRESSURE TEST OF SEVERAL MODELS IN AIR-CARBON-DIOXIDE MIXTURES IN THE 21-INCH HYPERSONIC WIND TUNNEL

Robert B. Blaylock 3 May 1964 12 p refs

(Contract NAS7-100)

(NASA-CR-59033; JPL-WT-21-141) OTS: $1.00 fs; $0.50 mf

The purpose of the test were to secure static pressures along the model surface and to survey the flow field from the model surface to the bow shock in mixtures of air–carbon

dioxide. The approximate aerodynamic parameters for the test were Mach 4.0, 5.5, and 6.5, and Reynolds No./in. 0.10×10^6. The test variables and ranges were angle-of-attack from $-10°$ to $+10°$, angle-of-roll 0° to 90°, and 0% to 80% CO_2 in air mixture. The model configurations comprised a blunt nose-cylinder, a blunt nose-cylinder flare, a conical nose-cylinder flare, a spherical nose cone, and a wedge; their installations and dimensions are shown. The results of the test were reduced to pressure ratios and are on file. R.L.K.

N64-33215* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

TEST OF THE SPACE-GENERAL NIKE-IROQUOIS MODEL IN THE JPL 20-INCH SUPERSONIC WIND TUNNEL

Maurice J. Argoud 4 May 1964 54 p refs

(Contract NAS7-100)

(NASA-CR-58997; JPL-WT-20-576) OTS: $3.00 fs; $0.50 mf

The purpose of the test was to obtain aerodynamic characteristics and basic data in support of a theoretical investigation of the effects of interactions, between a body-shed vortex system and stabilizing surfaces, in producing induced vehicle rolling moments at higher Mach numbers. The approximate aerodynamic parameters were Mach 1.4 to 3.0 and Reynolds No./in. from 0.27×10^6 to 0.11×10^6. The test variables and ranges were angles-of-attack from $-4°$ to $+16°$ and angle-of-roll from 0° to $+60°$. The model configuration comprised a 29.4-inch-long centerbody with a 20° included-angle conical nose and six different afterbodies differing in the planform geometry of the attached stabilizing fins and, in one case, having a slight flare at the rear of the afterbody. Forces and moments, obtained for the complete configuration, were reduced to dimensionless coefficients and are presented in plots. R.L.K.

N64-33217* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

TEST OF THE SPACE-GENERAL NIKE-IROQUOIS IN THE JPL 21-INCH HYPERSONIC TUNNEL

Maurice J. Argoud 28 Mar. 1964 146 p refs

(Contract NAS7-100)

(NASA-CR-58850; JPL-WT-21-145) OTS: $4.00 fs; $1.00 mf

This is the description and evaluation of wind-tunnel tests on the Nike–Iroquois model. Basic aerodynamic data were obtained on the effects of interaction between a body-shed vortex system and stabilizing surfaces. The forces and moments were obtained for the complete configuration and were reduced to dimensionless coefficients in coordinates by digital computer. G.G.

N64-33218* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

FORCE TEST OF A COLD-WALL BLUNT-NOSE CYLINDER-FLARE MODEL IN AIR-CARBON-DIOXIDE MIXTURES IN THE JPL 21-INCH HYPERSONIC WIND TUNNEL

Robert B. Blaylock 15 Mar. 1964 42 p refs

(Contract NAS7-100)

(NASA-CR-59186; JPL-WT-21-148) OTS: $2.00 fs; $0.50 mf

A model comprised of a blunt nose and a cylinder with a flare underwent testing in a hypersonic wind tunnel to determine the effects of model wall temperature to free-stream stagnation temperature ratio on the aerodynamic parameters in carbon dioxide–air mixtures. A six-component internal, strain-gage balance was used to measure force and momentum data. Temperatures were recorded continuously from four thermocouples located in the model and were converted to a digitized signal. All resulting data were reduced to dimensionless coefficients and are presented in a plot series. G.G.

N64-33255 Aeronautical Research Council (Gt. Brit.)

MEASUREMENTS OF THE DIRECT OSCILLATORY DERIVATIVES FOR A LINEAR BENDING MODE ON FOUR RIGID HALF-SPAN MODELS AT SUBSONIC AND TRANSONIC SPEEDS, IN CLOSED AND SLOTTED TUNNELS

K. C. Wight and J. A. Nixon London, HMSO, 1964 21 p refs

Supersedes NPL-AERO-1061; ARC 24650

(ARC-R&M-3376; NPL-AERO-1061; ARC-24650) HMSO: 8s 6d

Measurements have been made of the direct damping and stiffness derivatives for four rigid half-span models oscillating in a linear bending mode about an axis near the root in high-speed wind tunnels. A Mach number range of 0.6 to 1.1 was covered, and the frequency parameter varied between 0.12 to 0.04. The effect of converting the slotted tunnel to a closed tunnel gave large changes in the stiffness derivatives, whereas the damping derivatives showed only small to moderate changes. Comparison with theory for the damping derivatives showed reasonable agreement, especially under closed-tunnel conditions. Author

N64-33296 United Aircraft Corp., East Hartford, Conn. Research Labs.

ADDITIONAL CALCULATIONS OF HYPERSONIC DYNAMIC STABILITY Quarterly Status Report No. 3, 29 May–28 Aug. 1964

Martin R. Fink Sep. 1964 41 p refs

(Contract NOw-64-0092-f)

(C910188-12; AD-606203)

Calculations of the hypersonic static and dynamic stability of ogive and ogive–cylinder fuselages, and rectangular and delta wings in the presence of those fuselages are presented. The results are compared with those calculated by Newtonian theory and by supersonic flow theories. A description is presented of wind tunnel models that are being constructed for tests to evaluate the predicted trends. Author

N64-33351 Grumman Aircraft Engineering Corp., Bethpage, N.Y.

PRESSURE AND HEAT TRANSFER MEASUREMENTS FOR MACH 21 FLOWS OVER A BLUNT PYRAMIDAL CONFIGURATION WITH AERODYNAMIC CONTROLS

Louis G. Kaufman, II Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1964 49 p refs

(Contract AF 33(616)-8130)

(FDL-TDR-64-120; AD-449437)

Pressure and heat-transfer data were obtained for Mach 21 flows over a blunt pyramidal configuration composed of a 70° sweepback delta-wing surface and two dihedral surfaces. Instrumented trailing-edge flaps were mounted in pairs on either the delta-wing or dihedral surfaces, and an uninstrumented ventral fin was attached during several test runs. The model was pitched at angles-of-attack between $-30°$ and $+45°$ for free-stream Reynolds numbers, based on model length of approximately 51 000. Author

N64-33358 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Res. Lab.

GENERAL RESEARCH: AN EXPERIMENTAL INVESTIGATION OF TURBULENT SHEAR IN JET-DRIVEN VORTEX CHAMBERS

D. H. Ross 1 Oct. 1964 68 p refs

(ATN-64(9227)-5; AD-449934)

Vortex flow inside a right circular cylinder driven by tangential jets placed in the curved wall was studied. The objective of this study was to determine the intensity of turbulence

existing in the enclosed vortex flows, which derived their angular momentum from a distribution of fluid jets. The turbulent tangential shear stress inferred from measurements was taken as a criterion of the intensity of turbulence; the values were obtained by applying an angular momentum balance, including the effects of end-wall boundary layers, to a vortex chamber having a central porous tube that extracted the angular momentum from the exit flow. The results presented in this report include the radial distribution of tangential shear stress, the variation of midradius shear stress with tangential Reynolds number, and the variation of turbulent-to-laminar shear-stress ratio with tangential Reynolds number. Author

N64-33471 Canadian Armament Research and Development Establishment, Valcartier

BALLISTIC RANGE MEASUREMENT OF THE HYPERSONIC AERODYNAMIC STABILITY CHARACTERISTICS OF A LIFTING RE-ENTRY VEHICLE. PART I: ANALYSIS

Hugh Conn (Computing Devices of Canada) Sep. 1964 44 p refs

(ARPA Order 133)

(CARDE-TR-512/64)

The trajectory of a hypersonic lifting reentry vehicle in a ballistic range is studied. The strong influence of the aerodynamic cross-coupling derivative, $C_{L_{\alpha\beta}}$, on the roll rate is found to be a principal feature of the motion. An analytical solution is presented that permits a manual evaluation of the stability derivatives. Author

N64-33529 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.

PRESSURE AND HEAT TRANSFER MEASUREMENTS FOR HYPERSONIC FLOWS OVER EXPANSION CORNERS AND AHEAD OF RAMPS, PART IV

Louis G. Kaufman, II Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jul. 1964 168 p refs

(Contract AF 33(616)-8130)

(ASD-TDR-63-679, Pt. IV; AD-607038)

Pressure and heat-transfer data were obtained for hypersonic flows over 40° expansion corners and ahead of ramps. Full and partial span ramps, having wedge angles up to 90°, were tested at two locations on a sharp-leading-edge flat plate, with and without end plates. Pressure data were obtained for $M_\infty = 5$ for model-length Reynolds numbers between 1.1 and 6.6 million. Both pressure and heat-transfer data were obtained for $M_\infty = 8$ for Reynolds numbers between 1.1 and 3.3 million. Author

N64-33586 General Applied Science Labs., Inc., Westbury, N.Y.

SIMILARITY PARAMETERS FOR SUBLIMING BODIES IN HYPERSONIC FLOW

Paul A. Libby 7 Aug. 1964 36 p refs

(ARPA SD-149; ARPA Order 396)

(TR-453; AD-445833)

The parameters that must be simulated in dynamic testing of subliming bodies in hypersonic flows are discussed. By idealizing both the boundary layer and the thermal layer within the body, the describing equations for each system are written down and nondimensionalized. The boundary conditions at the interface of the two layers, i.e., at the instantaneous surface of the body, couple the two systems. Consideration of that coupling leads to a discussion of the necessity for simulation of the free-stream Mach number. Author

N64-33646 Army Missile Command, Huntsville, Ala.

THE EFFECT OF NOSE SHAPE AND AFTERBODY LENGTH ON THE NORMAL FORCE AND NEUTRAL POINT LOCATION OF AXISYMMETRIC BODIES AT MACH NUMBERS FROM 0.80 TO 4.50

Donald J. Spring 15 Jul. 1964 36 p refs

(RF-TR-64-13; AD-445278)

The experimental results for the supersonic Mach numbers 1.50 to 4.50 are compared with the second-order shock expansion theory of Syverston and Dennis. The comparisons indicate satisfactory agreement for all configurations within the range of applicability of the theory. The data indicate that when the nose parameters are varied over their entire range, no apparent effect in normal force is found until the Mach number exceeds 1.75. The neutral point location changes with each parametric variation regardless of the Mach number. Increasing the afterbody length gives an increase in normal force up to a Mach number of 1.75. Above Mach number 1.75, an increase in afterbody length does not change the normal force. The neutral point location shifts rearward and does not show any Mach number effect. The normal force and neutral point location variation with Mach number for each configuration exhibits the behavior generally shown by previous experiments with slender-body shapes. Author

N64-33650 Toronto U. (Canada) Inst. for Aerospace Studies

EXPERIMENTAL STUDY OF THE AERODYNAMIC CHARACTERISTICS OF A MODEL OF AN AIR CUSHION VEHICLE IN HOVERING FLIGHT

B. W. Gowans Feb. 1964 78 p refs

(Contract AF 33(657)-8451)

(UTIAS-TN-74; AD-446189)

A self-propelled model of an air cushion vehicle has been built and flight tested. A detailed study of the flow through the model has been made, and the jet mass and momentum fluxes have been measured. An augmentation curve and the basic static and dynamic stability characteristics in pitch have been obtained for the model while in hovering flight. Author

N64-33845 Lockheed Missiles and Space Co., Sunnyvale, Calif.

STATIC PRESSURES AND FORCES GENERATED BY A FLOW SEPARATION DISK

Lars Eric Ericsson Jul. 1964 61 p refs

(LMSC/804382)

An analysis has been made of static pressure and force data obtained on a disk in the Mach number range $1.5 \leq M \leq 5$. The spike tip was either a 20° blunted cone or a 15° cone with a spherical tip. The disk had a diameter of 2.667 spike calibers and was located 6 to 10 calibers aft of the spike tip. The analysis shows that the disk-induced flow separation introduces nonlinear and discontinuous changes with angle-of-attack. In spite of this the separated flow effects can, in general, be predicted by simple analytical formulas. Author

N64-33936 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

MEASUREMENT OF BASE PRESSURE IN FREE FLIGHT

G. I. Mishin 18 Sep. 1964 10 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1963 p 116–118

(FTD-TT-64-373/1+2; AD-607145)

The dependence of base pressure on the Mach number for cylindrical bodies that have a hemisphere-shaped front section, in the range from M = 1.32 to M = 2.91, and in the

range of Reynolds numbers (R_L) from $0.9 \cdot 10^6$ to $2.0 \cdot 10^6$, was investigated with a modernized ballistic unit. The experimental method used the deflection of a rubber diaphragm at the base of the model that sealed off a small cavity filled with air, at 1 atm and at the ambient temperature. Details of construction and of preliminary tests are given. D.E.W.

N64-33942 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPLICATION OF THE NEWTON RESISTANCE LAW TO THE CALCULATION OF AERODYNAMIC COEFFICIENTS OF BODIES OF ROTATION AT GREATER SUPERSONIC VELOCITIES
Ya. G. Kovalev 1 Oct. 1964 7 p refs Transl. into ENGLISH from Vopr. Analit. i Prikl. Mekhan. (Moscow), 1963 p 157–160
(FTD-TT-64-561/1; AD-607123)

Formulas are derived on the basis of the Newton resistance law for the calculation of aerodynamic coefficients of a body of rotation at high supersonic velocities. Shapes considered include the sphere, the cone with spherical tip, and the truncated cone. D.E.W.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-33390* Consultants and Designers, Inc., Arlington, Va.
A WING OF FINITE SPAN IN THE PRESENCE OF A MOVING SHOCK WAVE [KRYLO KONECHNOGO RAZMAKHA V PRISUTSVII DVIZHUSHCHEYSYA UDARNOY VOLNY]
E. A. Krasil'shchikova 31 Oct. 1964 8 p refs Transl. into ENGLISH from Aerodinamika, Dokl. Akad. Nauk SSSR, v. 158, no. 3, 1964 p 558–561
(Contract NAS5-3760)
(NASA-TT-F-8983; ST-AD-10232) OTS: $1.00 fs; $0.50 mf

Unsteady spatial flows of a compressible fluid, caused by wing motion and by a shock wave incident upon it, were investigated. A method developed in earlier papers and involving double hyperbolic integral equations is used for solution of the problem. D.E.W.

N64-33449 National Aerospace Lab., Tokyo (Japan)
MEASUREMENTS OF THE AERODYNAMIC DERIVATES OF AN OSCILLATING BICONVEX-FLAT AIRFOIL IN SUPERSONIC FLOW AT MACH NUMBER 2 TO 3
Takao Ishii and Mitsunori Yanagizawa Jan. 1964 19 p refs
(NAL-TR-57T)

The aerodynamic derivatives of a biconvex-flat airfoil (thickness ratio 10 percent), performing pitching oscillation in supersonic flow at the range of Mach number 2~3, were measured and compared with the linearized theory, piston theory, and Van Dyke's nonlinear theory that includes the effect of the airfoil thickness. The tested reduced frequency range was from 0.01 to 0.05; and the tested Reynolds number range was $2.8 \times 10^6 \sim 3.6 \times 10^6$ based on the chord length. In spite of the existence of the detached shock wave in front of the leading edge, the experimental results agreed quite well with the nonlinear theory. Author

N64-33951 ARO, Inc., Arnold Air Force Station, Tenn.
INVESTIGATION OF DRAG REDUCTION BY BOUNDARY-LAYER SUCTION ON A 50-DEG SWEPT TAPERED WING AT M_∞ = 2.5 TO 4
S. R. Pate Arnold Eng. Develop. Center, Oct. 1964 27 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-221; AD-450195)

Tests were conducted to determine the effectiveness of boundary-layer suction for laminar flow control on a tapered, three-dimensional, 50° swept supersonic wing. Test Mach numbers were 2.5, 3, 3.5, and 4 with a Reynolds number range (based on boundary-layer rake location) from 4.3 to 19.5 million for angles-of-attack of zero and ±3 deg. With suction, full-chord laminar flow was maintained for small angles-of-attack at M_∞ = 2.5, 3, and 3.5 up to length Reynolds numbers of 17, 12, and 9 million, respectively. Wake drag, suction drag, and total drag coefficients and the corresponding suction coefficients are presented, along with fully turbulent wake drag coefficients for the no-suction case. Author

N64-34014* United Aircraft Corp., Stratford, Conn.
CHARTS FOR ESTIMATING ROTARY WING PERFORMANCE IN HOVER AND AT HIGH FORWARD SPEEDS
Watson H. Tanner Washington, NASA, Nov. 1964 149 p refs
(Contract NASw-745)
(NASA-CR-114) OTS: $2.75

A systematic set of theoretical rotor performance charts for both hovering and high-speed forward flight are presented. The information was calculated by refined numerical methods that included stall and compressibility effects, with no small angle assumptions, for hinged rectangular planform blades of −8°, −4°, and 0° of linear twist. The charts presented cover the entire spectrum of high-speed rotary wing performance conditions for advance ratios from 0.25 to 1.4 and advancing tip Mach numbers of 0.7, 0.8, 0.85, and 0.9. Author

N64-34015* United Aircraft Corp., Stratford, Conn.
TABLES FOR ESTIMATING ROTARY WING PERFORMANCE AT HIGH FORWARD SPEEDS
Watson H. Tanner Washington NASA, Nov. 1964 169 p refs
(Contract NASw-745)
(NASA-CR-115) OTS: $3.00

Work tables are presented that contain both the information of the preceding report and additional information. These data apply to hinged rectangular rotor blades with geometric twists of −8°, −4°, and 0° and include a wide variation in rotor advance ratio, from 0.25 to 1.4, and a range of advancing tip Mach numbers from 0.7 to 0.9. Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-32830* California U., Berkeley
THE EFFECT OF RUNWAY UNEVENNESS ON THE DYNAMIC RESPONSE OF SUPERSONIC TRANSPORTS

C. C. Tung, J. Penzien, and R. Horonjeff Washington, NASA, Oct. 1964 123 p refs
(Grant NsG-348)
(NASA-CR-119) OTS: $2.75

An analysis has been developed for determining the dynamic response of airplanes to runway unevenness during takeoff or landing and has been programed for numerical solution on an IBM 7090 digital computer. This analysis permits the inclusion of the landing-gear nonlinear characteristics and the fluxural mode characteristics of the free-free airframe. In addition statistical methods of analysis of certain nonlinear systems, which may be applicable in determining the dynamic response of airplanes to runway unevenness of the stationary type, are also included. Author

N64-33109 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
ANALYSIS OF LONGITUDINAL RESPONSES OF UNSTABLE AIRCRAFT Final Report
Franklin F. Eckhart 30 Sep. 1964 90 p refs
(Contract NOw-61-0707-c)
(CAL-BA-1610-F-1; AD-450032)

The equations-of-motion method is applied to the problem of measuring the coefficients of the longitudinal equations of motion from in-flight response time histories of unstable airplanes. The equations-of-motion method was selected for this analysis since its use permits the pilot to continuously control the airplane during the time the response measurements are obtained. The response time histories used in the analysis were generated in flight with a variable stability T-33 airplane. Thirty-four sets of longitudinal dynamics, which included stable and unstable responses of various types, were recorded. The measured responses are fitted to the assumed equations of motion and the best-fit coefficients are extracted through use of the method of least squares. Conventional curve fitting techniques are used to examine the stable sets of longitudinal dynamics, and the results are compared to the equations-of-motion results. Author

N64-33110 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
FIXED-BASE SIMULATOR INVESTIGATION OF THE EFFECTS OF L_α AND TRUE SPEED ON PILOT OPINION OF LONGITUDINAL FLYING QUALITIES
Charles R. Chalk Nov. 1963 176 p refs
(Contract AF 33(657)-7442)
(CAL-TB-1630-F-1; AD-430012)

The effects of L_α and true speed on longitudinal flying qualities, optimum control gain, and normal acceleration response to turbulence were investigated in a ground simulator. The steady-state ratio of normal acceleration to angle-of-attack was found to be of significance both to the flying qualities of an airplane and to the optimum longitudinal control gain. Normal acceleration response to rough air was demonstrated to be primarily a function of L_α and the short-period frequency and damping ratio. Author

N64-33245 Flight Safety Foundation, Inc., New York, N.Y. Aviation Safety Engineering and Research
SYNTHESIS OF AIRCRAFT (CRASH) FIRE, RESCUE, AND EVACUATION TECHNOLOGY
H. G. C. Henneberger, H. F. Roegner, and L. Cambeis Washington, FAA, Jul. 1964 251 p refs
(Contract FA-WA-4458; Proj. SAFRET)
(ADS-16)

A description of an accomplished program is given wherein technical literature on postcrash aircraft fire, rescue, and evacuation was gathered and integrated into a system whereby persons conducting research on the subject might identify needed documents containing specific areas of information rapidly. The basic implements of the system are a code book, an IBM tab run, and a bibliography with an abstract for each document listed. The user desiring information finds a coded number in the code book corresponding to his specific area of interest, identifies all applicable documents in the tab run, and then reads abstracts of the documents in the bibliography to determine which documents to acquire to further his research. Major categories in which the collected material is indexed are: hazard exposure, design, test and analysis, and human factors. Author

N64-33270 Cook Electric Co., Morton Grove, Ill. Tech-Center Div.
STUDY OF PARACHUTE PERFORMANCE AND DESIGN PARAMETERS FOR HIGH DYNAMIC PRESSURE OPERATION Technical Documentary Report, 1 Jul. 1962–31 Dec. 1963
P. E. Pedersen Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1964 116 p refs
(Contract AF 33(657)-9182)
(FLD-TDR-64-66; AD-607036)

Parachute deployment velocities, ranging between Mach 1.0 and 1.5, were obtained with the Tomahawk parachute test sled operating in either single stage or double stage, pusher configuration. Parachute types that were investigated included Hyperflo, Hemisflo, Reefed Conical Ribbon, and Supersonic Guide Surface designs. The data obtained included inflation characteristics, opening shock factors, drag coefficients, inflated areas, stability, canopy temperatures, and general structural and aerodynamic design considerations. The test vehicle system including associated deployment and release techniques and the data acquisition system are also discussed. Author

N64-33937 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CURRENT ASPECTS OF THE THEORY OF STABILITY AND CONTROL OF AIRCRAFT
T. Khaker 18 Sep. 1964 41 p refs Transl. into ENGLISH from Rev. Mecan. Appl., Acad. RPR (Rumania), v. 8, no. 2, 1963 p 193–216
(FTD-TT-64-396/1+2+4; AD-607155)

Aircraft stability concepts are reviewed and redefined, and the construction of mathematical models is discussed. Two models are presented of the theory of controlled-flight stability. The first model considers the stability of partially controlled motion, and the second model treats questions of the stability of automatically controlled flight. New calculation methods and the use of electronic computers are also discussed. D.E.W.

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-32995* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE ABSOLUTE SPECTRAL-ENERGY DISTRIBUTION OF CANOPUS
R. H. Norton 15 Aug. 1964 34 p refs
(Contract NAS7-100)
(NASA-CR-59162; JPL-TR-32-641) OTS: $2.00 fs; $0.50 mf

Astronomical observations of the spectral-energy distributions (SED) of 12 stars are presented, including Canopus. Computational procedures for reducing these observations to a system of absolute units of flux outside the Earth's atmosphere are discussed, and the resulting absolute SED are given. Because of its special importance for guidance and control purposes, the SED of Canopus has been corrected for the effect of absorption lines, and the observations have been supplanted in the ultraviolet and infrared by a theoretical model atmosphere. Author

N64-32998* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

THE ANALYSIS OF UNCOOPERATIVE RADAR TARGETS

R. M. Goldstein 1 Sep. 1964 16 p refs
(Contract NAS7-100)
(NASA-CR-58777; JPL-TR-32-658) OTS: $1.00 fs; $0.50 mf

By far the least cooperative targets likely to be accessible to radar are the planets. This lack of cooperation stems from the all but incredible distances involved. However, when the modern high-power transmitter, large antenna, and ultrasensitive receiver are teamed together, these targets are detectable. In fact, echoes from Venus, Mars, Mercury, and Jupiter have been detected. When the received power is large enough so that there is some margin left over from the requirements of straight detection, it becomes possible to gather much information about the target. Each point of the target has two attributes that can be measured independently at the receiver—its round-trip distance (or time delay), and its velocity (or doppler shift). This paper discusses the special modulation and detection processes that enable the target to be analyzed into these two dimensions simultaneously. Such a system was used with Venus as the target during the conjunction of 1962. Author

N64-33051 Copenhagen U. (Denmark) Astronomical Observatory

A THREE-DIMENSIONAL SPECTRAL CLASSIFICATION OF G AND K STARS

Kjeld Gyldenkerne Repr. from Kgl. Danske Videnskab. Selskab, Mat. Fys. Skrifter (Copenhagen), v. 2, no. 9, 1964 57 p refs *Its* Publ. Og Mindre Medd. Fra Kobenhavns Obs. No. 178

On the basis of three classification indices *k*, *n*, and *m*, related to the break around the H- and K-lines, to the cyanogen absorption at 4200 Å and to a broad absorption of the continuum, a system of three independent classification parameters *S*, *L*, and *C*, has been established for stars of spectral types G 5–K 3.5 and luminosity classes II–III to IV. The parameter *S* is closely related to average MK spectral types, parameter *L* to the luminosity, and *C* is a third parameter that measures the remaining dispersion and is probably related chiefly to the chemical composition. With systematic dependence also on *S*, absolute magnitudes M_v (*k*, *n*, *m*) have been derived from *L* on the basis of M_v given by trigonometric parallaxes (main-sequence stars), cluster parallaxes (Hyades) and M_v (*K*) determined by the Wilson–Bappu method for a large body of giant stars. The $M_v(k,n,m)$ and $M_v(K)$ values agree with a scatter that corresponds to a mean error of $\pm 0^m.46$ for each of the two sets of absolute magnitudes. Author

N64-33056* Canterbury U., Christchurch (N. Zealand)

EFFECT OF THE MOON ON TERRESTRIAL METEOR RATES

C. D. Ellyett and C. S. L. Keay Repr. from J. Geophys. Res., v. 69, no. 7, 1 Apr. 1964 p 1397–1401 refs
(Grant NsG-219)

This is a re-analysis of nonnormal Christchurch meteor rate date obtained during 1960–1961, in terms of the lunar synodic decimal tables. The graphs of the Christchurch all-sky data gathering show variations of no more than 10% above the mean, so that either a solar or lunar effect must be very small. G.G.

N64-33112 Oklahoma State U. Research Foundation, Stillwater

A STUDY OF LINE INTENSITIES IN THE SPECTRUM OF θ URSAE MAJORIS Final Technical Report

Hugh Oscar Peebles (Ph. D. Thesis) Oct. 1963 189 p refs
(Grant Nonr(G)-00017-61)
(AD-423935)

The application of idealized curves of growth to a study of the spectrum of the star θ Ursae Majoris is described. The curve of growth is the relation between the intensity of an absorption line and the number of absorbing atoms active in producing the line. The advantage of the curve of growth lies in the fact that it may be used to handle many observational data, namely, the equivalent widths of the lines. The disadvantage of the curve of growth arises from its being a statistical procedure that ignores information that might be obtainable from the shapes of certain lines. Results are presented and discussed for the following: Ca I, Ti I, Ti II, Cr I, Mn I, Fe I, Co I, and Ni I. P.V.E.

N64-33125* Montana State Coll., Bozeman

APPROACH TO EQUILIBRIUM IN THE CNO BI-CYCLE

Georgeanne R. Caughlan [1964] 55 p refs
(Grant NsG-430)
(NASA-CR-59217) OTS: $3.00 fs; $0.50 mf

Differential equations of the CNO bi-cycle are solved to obtain the abundances of carbon, nitrogen, and oxygen nuclei as functions of protons consumed per initial nucleus for hydrogen burning in the temperature range 10 to 50×10^6 °K. General features of the curves of abundance ratios for C^{12}, C^{13}, N^{14}, N^{15}, and O^{16} nuclei as functions of protons consumed are found to be insensitive to the temperature at which the reactions take place. The resonance at 65 keV in the $O^{17}(p,a)$ reaction is responsible for the temperature dependence of ratios involving O^{17} nuclei. Analysis is made of the effect of convection with microscopic mixing on CN material passing through a hydrogen-burning zone. If a simple linear relationship or a sinusoidal relationship is assumed for the time dependence of temperature, the ratios of abundances attained at the surface in a given time are the same whether the time is spent in a single transit to the surface or in several transits back and forth from the bottom of the hydrogen-burning zone to the surface of the star. Author

N64-33212* Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE VELOCITY OF FAINT METEORS

Gerald S. Hawkins, Bertil-Anders Lindblad, and Richard B. Southworth 1964 10 p refs *Its* Contrib. to Astrophys. Vol. 8, No. 4
(Contract NASr-158)
(NASA-CR-59201) OTS: $1.00 fs; $0.50 mf

Preliminary measurements of meteor velocity to a limiting magnitude of +10 have been obtained with a multistation radar system. A systematic change in the average velocity of meteors, which depends on the magnitude and hence on the size, has been found. Between magnitude +6 and +9 the velocity decreases by 5 km sec^{-1}. There are indications that the effect becomes more marked for meteors fainter than +9. This effect is attributed to the difference in orbits within the various meteor populations. Author

N64-33220* Florida State U., Tallahassee
[RADIO OBSERVATION OF JUPITER] Status Report No. 5, 1 Feb.–31 Jul. 1964
C. H. Barrow [1964] 13 p refs *Its* Rept.-092364
(Grant NsG-224-61)
(NASA-CR-59202) OTS: $1.00 fs; $0.50 mf

Jupiter has not been well placed for radio observation during the period of the present report. Analysis of data taken in 1963 has continued, and a first report of the 18 Mc/sec spaced-site observations has been completed. Correlation coefficients between Jupiter activity and various indicators of solar activity have been computed, but these do not indicate any statistically significant cross correlation during 1963. A detailed study is now in progress to examine the possibility of a more complex relationship between the phenomena. Author

N64-33422 Army Missile Command, Huntsville, Ala. Translation Branch
CORRELATION OF STEPS OF A VISUAL BRIGHTNESS SCALE OF LUNAR OBJECTS WITH ABSOLUTE VALUES OF THE BRIGHTNESS FACTOR
N. Sytinskaya 21 Sep. 1964 5 p Transl. into ENGLISH from Astron. Tsirkuliar Akad. Nauk SSSR (Kazan), no. 144, 1953 p 11–12
(RSIC-273; AD-606780)

The problem of conversion from visual evaluations of the brightness of lunar objects on a 10-point Schröter scale to photometric data is considered, using a catalog of absolute visual values of the brightness factor of lunar formations published in 1953. A number of features were measured photometrically, and the data were compared graphically with visual values. An equation of a linear relationship was derived, and a table of correspondences is given. D.E.W.

N64-33451* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
THE RV TAURI POPULATION
Richard Stothers Repr. from Publ. Astron. Soc. Pacific, v. 76, no. 449, Apr. 1964 p 98–105 refs Previously announced as NASA-TM-X-50591
(NASA-RP-333; NASA-TM-X-50591)

The spatial distribution of RV Tauri supergiant stars in the field is discussed, and a comparison is made of their properties with similar stars in globular clusters. The RV Tauri stars were distinguished from the yellow semiregular stars on the basis of spectroscopic criteria of the U,B,V colors and strength of hydrogen emission. A strong concentration of the RV Tauri stars was found in the direction of the galactic center. By means of photographic magnitude of nine certain RV Tauri stars in clusters, a period-luminosity relation was established. Their low radial velocities and latitudes indicated a weak Population I group, but by their excessive blueness and discontinuous velocity curves, a Population II group seemed indicated. It was concluded that RV Tauri stars seem to form an intermediate subsystem between Population I and Population II. G.G.

N64-33457* High Altitude Observatory, Boulder, Colo.
AVERAGE RECOMBINATION GAUNT FACTORS
Helen P. Glasco and Harold Zirin Repr. from Astrophys. J., Suppl. Ser., v. 9, no. 90, Aug. 1964 p 193–200 refs
(Grant NsG-92)

This report includes a tabulation of the average hydrogenic Gaunt factor for the principal quantum numbers n = 1 to 15 for all individual l-values for temperatures from 2500° to 2 560 000° K, utilizing the extensive computation of hydrogenic recombination Gaunt factors for various electron energies. G.G.

N64-33458 California Inst. of Tech., Pasadena Owens Valley Radio Observatory
DECIMETER MEASUREMENTS RELATING TO THE POSSIBLE DISPLACEMENT OF JUPITER'S MAGNETIC DIPOLE
G. L. Berge and D. Morris 1964 5 p refs
(Contract Nonr-220(19))
(AD-444166)

Observations of Jupiter are described that were made with an interference polarimeter at a wavelength of 10.4 cm and an east–west separation of 800 feet or 2350λ. The equipment and its arrangement are discussed, and it is stated that the off-transit measurements with this parallel horn arrangement showed that the nonthermal, nonpolarized portion of the radiation reached the first null of its visibility function at an effective baseline of about 1860λ. The phase of the polarized radiation minus the phase of the thermal radiation is displayed as a function of wavelength. A synthetic dynamic decameter spectrum was constructed in which the observatory position was substituted for the dipole. D.E.W

N64-33680 Copenhagen U. (Denmark) Astronomical Observatory
PHOTOELECTRIC NARROW-BAND CLASSIFICATION OF LATE-TYPE STARS
Kjeld Gyldenkerne 1964 14 p refs *Its* Publ. Og Mindre Medd. Fra Kobenhavns Obs. No. 180

The three-dimensional S, L, C classification method for G and K stars is briefly outlined with some comments on the classification indices k, n and m. In addition, recent tests of a two-dimensional narrowband classification of M stars are described. Author

N64-33696* Harvard U., Cambridge, Mass.
ABUNDANCE OF IRON DERIVED FROM FAINT FRAUNHOFER LINES
Leo Goldberg, Andrea K. Dupree, and Roger A. Kopp Repr. from Astron. J., v. 69, no. 2, Mar. 1964, p 1317 ref
(Grant NsG-438)

Most recent determinations of the abundance of iron from the equivalent widths of Fraunhofer lines lie in the range 3.0 to 6.0×10^{-6} relative to hydrogen. Discrepancies between these values and those derived from the intensities both of forbidden lines and of far-ultraviolet permitted lines of highly ionized iron in the spectrum of the corona are discussed. D.E.W.

N64-33877* Battelle Memorial Inst., Columbus, Ohio
DEVELOPMENT OF LARGE-INTERNAL-SURFACE-AREA NICKEL METAL PLAQUES First Quarterly Progress Report, 18 Jun.–18 Sep. 1964
J. Mc Callum, G. R. Schaer, D. G. Trevethan, and C. L. Faust 22 Sep. 1964 40 p refs
(Contract NAS3-6003)
(NASA-CR-54114) OTS: $2.00 fs; $0.50 mf

Studies to improve nickel–cadmium batteries through the use of electroformed nickel plaques are progressing as follows: (1) Comparisons of the range of pore sizes in the electroformed screens with those in powdered plaques indicate that electrodes made from the screens will have pore sizes comparable with pores in commercial electrodes. (2) The feasibility of stacking screens into plaques with uniform pores of controlled shape was demonstrated. (3) Techniques for electroforming special screen structures are being evaluated. (4) Conditions have been selected for sintered plaque processing, and electroformed screens were stacked with a 45° orientation of wires and sintered into one-piece electrodes. (5) Commercial sintered

nickel-powder plaques are being evaluated to provide reference points with which to compare new electrode structures. (6) Similar reference data are being obtained for impregnation procedures and electrochemical battery evaluations. M.P.G.

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-32726* Pennsylvania U., Philadelphia Power Information Center

THIN FILM SOLAR CELLS AND SOLAR CELL TESTING, VOLUME II Proceedings of the Fourth Photovoltaic Specialists Conference

Aug. 1964 295 p refs Conf. held at NASA Lewis Res. Center, Cleveland, 3 Jun. 1964

(Contract NASr-191)

(NASA-CR-59014; PIC-SOL-209/5.1) OTS: $6.00 fs; $1.75 mf

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N64-32727* Radio Corp. of America, Princeton, N.J. RCA Labs.

HETEROJUNCTION PHOTOVOLTAIC CELLS

S. S. Perlman *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 11 p refs (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

A theoretical evaluation of heterojunction photovoltaic cells is presented. Short-circuit current densities, collection efficiencies, open-circuit voltages, and maximum power outputs are calculated and compared to those of equivalent homojunction cells made of the two semiconductor materials forming the heterojunction. The analysis considers the abrupt p-n heterojunction and treats only the case of uniform illumination. Open-circuit voltages and short-circuit current densities, as derived, cannot exceed the values obtained in the equivalent homojunction cells. Cell efficiencies for heterojunctions are thus bounded by the efficiencies of the corresponding homojunctions. Any advantages of heterojunction cells are limited to those arising out of the "window effect." Author

N64-32728* Radio Corp. of America, Princeton, N.J. RCA Labs.

PHOTOVOLTAIC PROPERTIES OF GaAs THIN FILMS

D. M. Perkins and E. F. Pasierb *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 21 p refs (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

Two distinct photovoltaic properties of vapor-deposited polycrystalline GaAs films are discussed. Surface barrier solar cells made on these films by evaporated Pt contacts are considered. Such cells in small areas have exhibited sunlight conversion efficiencies of 3% with a corresponding power-per-unit-weight ratio of 17 w/lb. An anomalous photovoltaic effect exhibited by some of the GaAs films is described. In this effect a photovoltage is generated, both the magnitude and sign of which depend on the angular orientation of the film relative to the illumination. Open circuit voltages of from 10 to 20 V are typically observed for angles-of-incidence of approximately 45°. Author

N64-32729* General Electric Co., Syracuse, N.Y. Electronics Lab.

PHOTOVOLTAIC JUNCTIONS ON POLYCRYSTALLINE CdTe

R. W. Aldrich *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 18 p (See N64-32726 24-06)

(Contract AF 33(657)-10601) OTS: $6.00 fs; $1.75 mf

Some aspects of the development of thin, polycrystalline, CdTe solar cells are discussed. The films for the cells are grown at low pressure by a vapor-reduction process. Doping of the films is accomplished by adding volatile halides (usually CdI_2 and CuCl) to the cadmium and tellurium powders. The cell substrate is molybdenum foil, which can be 1 mil, or less, thick. A layer of CdS is grown on top of the substrate by reacting H_2S and Cd. This layer serves as a base for the succeeding deposition of CdTe. A p-n heterojunction, between p-type Cu_2Te and n-type CdTe, is formed by reacting the CdTe with a hot solution of cuprous ions. Cells of 9-square-inch area have been made with efficiencies close to 4%, and smaller cells have been made with efficiencies of about 5%. P.V.E.

N64-32730* Clevite Corp., Cleveland, Ohio Electronic Research Div.

BACKWALL CdS FILM CELLS ON PLASTIC SUBSTRATES

Warren J. Deshotels and Frank Augustine *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 19 p refs (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

(Contract NAS3-2795)

A large area, backwall thin film, CdS solar cell on a plastic film substrate is described. This device offers promise of lighter weight and lower cost than other thin-film solar cell constructions. Two forms of the cell are described. One has a nominal area of 16 in^2. The other consists of nine 1-in^2 cells in a 3 × 3 array on a single 4- × 4-in. substrate. The substrate is a polyimide plastic that is stable at temperatures as high as 300° C and is transparent to all wavelengths of light essential to backwall cell operation. Both the plastic substrate and CdS film are reported, by others, to be extremely radiation resistant. The large-area cells have exhibited light conversion efficiencies up to 1.6%. The 1-$in.^2$ cells have exhibited individual cell efficiencies as high as 2.6%. Author

N64-32731* National Cash Register Co., Dayton, Ohio

CHEMICALLY SPRAYED THIN-FILM PHOTOVOLTAIC CONVERTERS

R. R. Chamberlin and J. S. Skarman *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 12 p refs (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

Some of the properties that have been obtained with CdS, Cu_xS_y chemically spray-deposited, thin-film, solar cells are described. Also discussed are fabrication and structure; temperature dependence of spectral response; and the present state of spray-deposited solar-cell art. It is concluded that photovoltaic cells produced by the technique of chemical-spray deposition do have properties that can be explained or interpreted as the result of a heterojunction between the p-type Cu_xS_y and the n-type CdS. P.V.E.

N64-32732* Harshaw Chemical Co., Cleveland, Ohio

RECENT CdS SOLAR CELL DEVELOPMENTS

J. C. Schaefer and R. L. Statler (Naval Res. Lab.) *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 11 p (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

A new barrier formation technique has been developed for the CdS thin-film photovoltaic solar cell that has resulted in an increase of more than 1 percent in solar-conversion efficiency. In the procedure, a freshly evaporated CdS film is taped to a board in such a manner as to form a mask around the entire periphery. It is then immersed in a CuCl water solution that is held below the boiling point. The time of immersion is approximately 1 second. The cells produced by this procedure appear to have a somewhat better resistance to moisture degradation while possessing a slightly different spectral response than the standard electrodeposited barrier. It is concluded that the new barrier formation technique promises to result in gains in cell-conversion efficiency, power-to-weight ratio, and ease of fabrication. P.V.E.

N64-32733* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

RADIATION DAMAGE TO CdS SOLAR CELLS

Henry W. Brandhorst, Jr. and Russell E. Hart *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 15 p (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

Irradiations were conducted on cadmium sulfide thin-film solar cells. Groups of 10 cells each were exposed to electrons of 2.5, 1.0, and 0.6 MeV, respectively. Total doses progressed from 10^{15} to 10^{17} electrons/cm^2 in decade steps. Four other groups of cells were exposed to 10, 7, 5, and 2 MeV protons in doses ranging, in decade steps, from 10^{12} to 10^{14} protons/cm^2. The cells in each group were subdivided according to type of plastic encapsulant—H-film, Mylar, and Tedlar. All of the Mylar and H-film cells reached 10^{17} electrons/cm^2 with no degradation of electrical characteristics. The Tedlar cells failed rapidly in the tests. After 10^{16} electrons/cm^2, H-film cells deteriorated badly. At 4 × 10^{14} protons/cm^2, the maximum power was 87% of its original value P.V.E.

N64-32734* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

SOLAR CELL CHARACTERISTICS, DETERMINED AS FUNCTION OF ELECTRON IRRADIATION AND TEMPERATURE ON TABLE MOUNTAIN

John H. Martin *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 14 p refs (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

An experiment was conducted in order to obtain an accurate indication of the effects of temperature and irradiation on solar cell performance in natural sunlight. It is concluded that investigations of solar cell properties may be more accurately undertaken with artificial solar simulation than with natural sunlight at any point on the earth's surface. For comparative analysis, solar simulation can be more reliable than natural earthbound sunlight. However, natural sunlight is at present a better means of illumination for systems tests. It is further concluded that, in general, solar cell power supplies should be designed for operation between 0.33 V/cell and 0.375 V/cell with consideration being given to orbit, anticipated array temperatures, irradiation environment, and expected lifetime of the spacecraft. P.V.E.

N64-32735* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

AIRPLANE TESTING OF SOLAR CELLS

Henry W. Brandhorst, Jr. *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 17 p (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

The use of an airplane to obtain outer space short-circuit currents by use of a Langley plot has several advantages: (1) It is above ground haze and low-lying atmospheric disturbances. (2) Instrument errors on any one point do not appreciably affect the extrapolated value of the outer space short-circuit current. (3) The airplane is a convenient, versatile, and stable system whose flying time is practically unlimited. From the data obtained, it is concluded that high-altitude aircraft can be used to calibrate solar cells, and that the accuracy of such a measurement is ±1%. P.V.E.

N64-32736* Radio Corp. of America, Mountain Top, Pa.

COMPARISON OF FLIGHT AND TERRESTRIAL SOLAR MEASUREMENTS ON SILICON CELLS

F. J. Mc Kendry, H. W. Kuzminski, and C. P. Hadley *In* Pa.U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 12 p refs (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

The variability of testing conditions during terrestrial measurements of solar cells generates several percent spread in resulting data. In order to overcome this problem, especially in the generation of standard cells, it was considered that the flying of solar cells would remove the variability. Cells were flown to altitudes of about 10 000 to 47 000 ft. Extrapolation to air-mass zero was accomplished using the flight data. Measurements were also made using balloon standards. Comparison of the air-mass zero values and terrestrial measurements showed disagreement with computed methods to the extent of about 8%. Author

N64-32737* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

THE SPACE CALIBRATION OF STANDARD SOLAR CELLS USING HIGH-ALTITUDE BALLOON FLIGHTS

J. A. Zoutendyk *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 32 p refs (See N64-32726 24-06) (Contract NAS7-100) OTS: $6.00 fs; $1.75 mf

The data presented in this paper illustrate the feasibility of obtaining space short-circuit current calibrations on solar cells by using high-altitude balloon flights. The accuracy of such calibrations has been shown to be ±0.6% or better. The calibrations have been shown to be repeatable to within better than ±0.5% for three individual flights flown over a period of more than one year. Author

N64-32738* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

DEVELOPMENT OF PHOTOVOLTAIC STANDARDS FOR NASA

D. W. Ritchie *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 41 p refs (See N64-32726 24-06) (Contract NAS7-100) OTS: $6.00 fs; $1.75 mf

The method proposed for calibration and correlation of solar cell shortcircuit current to outer space from terrestrial measurements has been demonstrated. The extrapolation of terrestrial measurements as compared to data obtained from high-altitude balloon flights shows that the shortcircuit current of solar cells in space can be predicted to an accuracy of better than 2%. The methods also show that solar cells require similar spectral response to maintain extrapolation accuracies. Author

N64-32739* Space Technology Labs., Inc., Redondo Beach, Calif.

SOLAR ARRAY SHADING AND A METHOD OF REDUCING THE ASSOCIATED POWER LOSS

W. R. Baron and P. F. Virobik *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 5 p (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

The problem of partial or total shading of one or more cells in a series–parallel configuration of solar cells is discussed. The method used to overcome these problems on the Pioneer spacecraft is to shunt the shaded or potentially shaded solar cells with semiconductor diodes connected in the opposite forward direction to the solar cell internal p-n junction (parallel opposition). The shunt diodes are connected in such a manner that they are reverse biased at cell operating voltage when all the cells are fully illuminated and, therefore, the shunt diode losses are negligible. When the shunted solar cells are shadowed, the diodes conduct the load current from the remainder of the illuminated cells. P.V.E.

N64-32740* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

THE FILTER WHEEL SOLAR SIMULATOR

Joseph Mandelkorn *In* Pa. U. Thin Film Solar Cells and Solar Cell Testing Aug. 1964 14 p refs (See N64-32726 24-06) OTS: $6.00 fs; $1.75 mf

A filter-wheel simulator consists of eight sharp cutoff filters mounted along the periphery of a vertical wheel. A tungsten light source and a holder for two silicon solar cells are on opposite sides of the wheel. One of the two cells in the holder is permanently mounted and monitors the intensity of the light output of each filter when it is brought into position in front of the light source. The second cell is the one to be measured. Because of the good agreement obtained between the simulator and airplane measurements on solar cells, it is suggested that this type of simulator is the foremost contender for adoption as the standard for solar-cell measurement. Also, the filter-wheel simulator converts to an instrument for the analysis of spectral response, antireflective-coating performance, and bombarded solar-cell behavior with only slight modifications required. P.V.E.

N64-32770* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ELECTRIC POWER GENERATION

Newell D. Sanders, James F. Morris, Lester D. Nichols, Andrew E. Potter, Jr., Harvey J. Schwartz et al *In its* Conf. on New Technol. 1964 p 65–89 ref (See N64-32767 24-01) GPO: $1.00

New developments in electric-power generation that originated in the space program or allied programs are discussed, with emphasis on future earth-bound applications. The topics discussed are batteries, solar photovoltaic cells, thermoelectric converters, fuel cells, turbine conversion systems, magnetohydrodynamic converters, and thermionic converters. In each case, the fundamental principles are explained briefly, the state-of-the-art for space applications is discussed, and future applications are predicted. M.P.G.

N64-32831* Astro Research Corp., Santa Barbara, Calif.

ROTARY, DEPLOYABLE SPACE SOLAR POWER SUPPLY

H. Schuerch and W. Robbins Washington, NASA, Oct. 1964 88 p refs
(Contract NASw-652)
(NASA-CR-122) OTS: $2.25

Fresnel reflectors deployed by spin alone and maintained by spin in a precisely flat, circular disk that can provide high geometrical accuracy are investigated. Since no stiffness of the reflector is required or desired it can be made very thin and hence very light. A passive heliotropic system, operating on solar radiation pressure, is proposed, which is compatible with very lightweight, spin-stabilized construction. The use of a deployable, solid-state convective-heat-transport device in the form of a running belt system is investigated. Preliminary experiments of heat transfer in vacuum are made. Two sizes (15 and 150 kW) of rotary deployable space power supply are chosen to evaluate specific application of the above investigations; modified Huettner turbines are proposed. Author

N64-32853 Argonne National Lab., Ill. Reactor Engineering Div.

VAPOR CYCLE COOLANT REQUIREMENTS FOR NUCLEAR SPACE POWER PLANTS

Marion J. Janicke Mar. 1964 97 p refs
(Contract W-31-109-ENG-38)
(ANL-6857) OTS: $3.00

Interplanetary space travel will require electric power in excess of 1 to 10 MW. Present designs show that for these power demands, a coolant, rather than a radiation or conduction, heat-transmission scheme will be required for the economic use of powerplant weight. Of the various electrical conversion systems, the turboelectric system appears to be the most promising method for supply of this energy. The choice of the coolant is the most important decision in the planning of any space powerplant. Liquid metals are especially suited for reactors with high thermal fluxes and high operating temperatures, because of their high thermal conductivities, low vapor pressures, and relatively high volumetric heat capacities. They are stable at high temperatures and in intense radiation fields. Author

N64-32883 General Motors Corp., Anderson, Ind. Delco-Remy Div.

SILVER-ZINC SECONDARY BATTERY INVESTIGATION

Quarterly Technical Progress Report, 1 Apr.–1 Jul. 1963

J. J. Lander and J. A. Keralla 2 Jul. 1963 28 p
(Contract AF 33(657)-8943)
(QTPR-4; AD-420199)

Three sealed 25 A-h cells constructed with positive plates to which 1% palladium was added by impregnation with a palladium salt have completed 2900 cycles of operation at 80° F. Six additional sealed 25 A-h cells containing positive plates made with 1% palladium silver powder have reached 1400 cycles at 80° F. Hydrogen evolution studies at 75° F have been completed. The results indicate that 4% HgO addition to the negative plate in 45% KOH results in the least amount of gas production in a 30-day period. Sealed 25 A-h cells containing 2% and 4% HgO additions in the negative plate material have completed 833 and 620 cycles, respectively, during operation at 25% depth of discharge at 80° F. Two 25 A-h cells, one containing regular silver plates and the other containing 1% palladium silver plates, were cycled at 15° F at 25% depth of discharge. The zinc negative plate is limiting cycle life at this temperature. Author

N64-32932 Martin Co., Baltimore, Md. Nuclear Div.
INVESTIGATION OF GAS PRESSURE BUILDUP IN THERMOELECTRIC SNAP GENERATORS
W. A. Mc Donald and J. Mc Grew Jan. 1964 44 p refs
(Contract AT(30-1)-3143)
(MND-3143-1)

The gas pressure increase in the generators that were initially filled with dry inert gas results from the following: (1) decomposition of the phenol–formaldehyde resin that is used as a binder in the Min-K 1301 thermal insulation; and (2) desorption of atmospheric gases and water vapor that adsorb on the surface of the insulation. The degree of gas release in both cases was determined to be temperature and pressure dependent. Author

N64-32951 Stanford U., Calif.
DIRECT ENERGY CONVERSION SYSTEMS: THE TRANSIENT RESPONSE OF THERMOELECTRIC GENERATORS
Semiannual Technical Summary Report, 1 Apr.–1 Oct. 1963
Carl B. Moyer and Robert H. Eustis 20 Oct. 1963 202 p refs
(Contract AF 49(638)-1123; Grant NSF-GP-948; ARPA Order 246-62)
(AD-423163)

The problem considered is that of the startup of a thermoelectric generator. Initially the generator is specified to be at a uniform temperature. A step power input is applied to the hot junction bus bar, and the cold junction temperature remains constant. The problem is first considered with all material properties assumed constant. The governing differential equations and boundary conditions are set down, and then nondimensionalized in order to discover the essential parameters that influence the transient behavior of the generator. The constant properties problem is then solved by two methods—an explicit finite difference method and an approximate integral analysis. The results of the two analyses agree very well. Some experimental data indicate, however, that the constant properties predictions are useful only for predicting the temperature response of the device. Author

N64-32988* Case Inst. of Tech., Cleveland, Ohio Digital Systems Lab.
A DIGITAL COMPENSATOR FOR AUTOMATIC CONTROL SYSTEMS
Robert W. Kearns Jun. 1964 221 p refs
(Grant NsG-36-60)
(NASA-CR-59053; EDC-1-64-23) OTS: $6.00 fs; $1.00 mf

A full adder–subtractor utilizing one transistor in the carry–borrow signal path is presented. This circuit is incorporated in an arithmetic unit that performs addition, subtraction, multiplication, and division. The unique arithmetic unit, in turn, is incorporated in a multi-increment digital integrator. By means of a magnetic drum memory unit, the one arithmetic unit is time shared among 18 integrators. The 18 integrators are designed into a digital compensator for a simulated plant. The one digital compensator, in turn, can be time shared to control many plants simultaneously. A current mapping technique for implementing the circuit logic is presented. A digital to ac converter is developed. An ideal program for the digital compensator is synthesized for the simulated plant as an example of the use of the compensator. The ideal program is based upon minimizing Wieners mean square error functional. Author

N64-32990* Case Inst. of Tech., Cleveland, Ohio Digital Systems Lab.
DIGITAL CONTROL SYSTEM COMPENSATION TO OBTAIN CONTINUOUS-SYSTEM OPERATION
Albert Louis Holliman Jun. 1964 98 p refs
(Grant NsG-36-60)
(NASA-CR-59035; EDC-1-64-26) OTS: $3.00 fs; $0.50 mf

A compensation technique is described for improving the time response of the controlled variable for an incremental digital feedback control system. Compensation signals, supplied with the pulse input signal and generated within the system, provide a continuous reference-input signal, a continuous feedback signal, and a resulting continuous system error signal. The compensated system then exhibits the behavior of a continuous analog feedback control system rather than that of a discontinuous digital control system. However, the compensated system retains the principal advantages of the uncompensated digital system, such as an easily transmitted digital input signal and a very accurate digital component in the feedback signal. An experimental model of a compensated digital control system is described. Author

N64-33100* Radio Corp. of America, Princeton, N.J. RCA Labs.
VAPOR-FILLED THERMIONIC CONVERTERS Mid-Point Report
K. G. Hernqvist, J. R. Fendley, and J. D. Levine Sep. 1964 70 p refs
(Contract NAS3-4173)
(NASA-CR-54194) OTS: $3.00 fs; $0.75 mf

Electrical conductivity due to cesium adsorption on insulators has been studied extensively. For "clean" ceramic systems (defined roughly as continuously gettered systems, or closed systems in initial stages of life) conductivity of adsorbed cesium in equilibrium with cesium vapor follows a simple Arrhenius law. For "unclean" systems (defined roughly as closed systems in later stages of life where gases can accumulate) conductivity is larger and obeys a similar law. Conductivity kinetic studies show that conductivity is proportional to the fourth power of arrival rate and of time after admitting a cesium beam. Plasma phenomena affecting the volt–ampere characteristic of the arc mode thermionic converter are discussed. Probe measurements of electron temperature are described. The measurements indicate electron temperature in the 3000° to 4000° K range. Author

N64-33186* Borden Chemical Co., Philadelphia, Pa.
RESEARCH AND DEVELOPMENT OF SEPARATORS FOR SILVER OXIDE–ZINC AND SILVER OXIDE–CADMIUM CELLS FOR SPACECRAFT APPLICATION Fourth Quarterly Report, Mar. 28–Jun. 27, 1964
H. E. Hoyt and H. L. Pfluger [1964] 55 p ref
(Contract NAS5-3467)
(NASA-CR-57013) OTS: $3.00 fs; $0.50 mf

Cycle-life tests on cells built with earlier-developed membranes were completed. A number of these showed longer cycle life than a control set of cells built with PUDO cellophane. Each of six selected membrane types was included in seven cells for further testing. Comparative tests were continued on the stability of the membranes both to 30% and 40% aqueous potassium hydroxide and to these solutions saturated with silver oxide. All membranes were more resistant to the oxidative action of silver oxide in the higher concentration of KOH. The methyl cellulose modifications retained a good strength and electrical conductivity. Electrolyte absorption by membranes was measured as was the distribution of KOH and water in the membranes at equilibrium. D.E.W.

N64-33187* Yardney Electric Corp., New York, N.Y.
RESEARCH AND DEVELOPMENT STUDY OF THE SILVER-CADMIUM COUPLE FOR SPACE APPLICATION Fourth Quarterly Progress Report, Apr. 1–Jun. 30, 1964
Allen Charkey and G. A. Dalin [1964] 41 p
(Contract NAS5-3452)
(NASA-CR-57014) OTS: $2.00 fs; $1.75 mf

Two groups of cells operating on the short and long orbit regimes have completed 900 and 75 cycles, respectively. A recent deep discharge showed that lowering the positive plate density has a beneficial effect on cell capacity. Difficulties have resulted from cycling cells of different construction as multicell batteries. Differences in capacity have led to overcharge in individual cells and excessive pressure rise. This difficulty has been overcome by construction of a cycler with automatic cutoff for each cell. Several cells that feature a combination of C19 and PVA with a separator inert to oxidation by silver have completed 50 high rate deep cycles at 50° C with excellent capacity maintenance; the controls shorted at cycle 35. The performance of cells fabricated with partially wet-proofed cadmium electrodes appears to be satisfactory after 400 shallow short orbit cycles. Author

N64-33209* Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
STUDY OF ENERGY CONVERSION SYSTEMS Summary Report, 8 May 1963–15 Jun. 1964
R. W. Opperthauser and J. F. Euclide 15 Jun. 1964 96 p refs
(Contract NAS8-5392)
(NASA-CR-58852) OTS: $3.00 fs; $0.75 mf

A static moisture-removal system for the capillary membrane hydrogen–oxygen fuel cell was tested for feasibility, and various aspects of its operation and performance were investigated. A gas chromatograph was used to measure water vapor at various places in operating fuel cells. It was also used to measure hydrogen diffusion through the water removal membrane. Studies of the system were made to determine optimum system configuration. Computer programs were written to determine minimum weights for various missions and for systems made up of fuel cells alone or fuel cells combined with batteries. Comparisons were made between fuel-cell systems and low-temperature expansion systems as well as those formed by the combination of the two. Author

N64-33316 Monsanto Research Corp., Everett, Mass. Boston Lab.
FUEL CELL MEMBRANE ELECTRODE CONFIGURATION
Max C. Deibert 31 Aug. 1964 24 p
(Contract DA-49-186-AMC-166(X))
(MRB-4020TI; AD-606289)

A new method of fabricating fuel-cell-membrane electrodes has been developed that yields polytetrafluoroethylene-containing, platinum-black catalyzed electrodes, which are highly active as hydrogen, hydrazine, methanol, and propane anodes and as oxygen cathodes. The electrochemical activity of these membranes, together with the activity of carbon-black polytetrafluoroethylene membranes of similar structure, has been measured in half-cell and full-cell experiments. The membranes containing carbon black appear to be promising as support structures for metal chelate catalysts. The electrode fabrication technique is simple and appears to be applicable to many other combinations of fuel-cell catalyst or catalyst support powders and hydrophobic binder materials. Author

N64-33357 MB Associates, San Ramon, Calif.
ANALYSIS AND TEST OF EXPLOSIVELY DRIVEN MAGNETOHYDRODYNAMIC PULSE GENERATOR
Feb. 1964 84 p
(Contract AF 33(657)-11562)
(MB-R-63/97; AL-TDR-64-11; AD-431593)

This program has successfully demonstrated that electrical power can be generated from high explosives by magnetohydrodynamic means. Power of 1.1 MW was generated and supplied to an FX-1 flash tube. The low efficiency of the units produced during this project does not make them practical as generators of electrical energy. Efficiency can be improved substantially by employing larger generators, and by designing the load to match the generator characteristics. Author

N64-33526 Westinghouse Electric Corp., Pittsburgh, Pa.
CEROLYTE FUEL CELLS
D. H. Archer, E. F. Sverdrup, L. Elikan, and W. A. English Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., [1964] 58 p refs
(Contract AF 33(615)-1425)
(QTPR-2; AD-607146)

This is a report on the measurements of the polarization voltage losses and the overall design of a 50-watt cerolyte fuel-cell battery. A preliminary battery design has been completed that consists of a metal base plate for the battery manifolding and tubular battery support, the battery casing, and the insulation. The polarization voltage losses for large crystal-fused platinum electrodes, both absorbing and desorbing oxygen, were obtained. G.G.

N64-33535 Durham U. (Gt. Brit.)
LABORATORY INVESTIGATION OF GEOMAGNETIC DYNAMOS Technical (Final) Report
F. J. Lowes and I. Wilkinson Feb. 1964 48 p refs
(Contract AF 61(052)-213)
(AFCRL-64-768; AD-606831)

By rotating two cylindrical ferromagnetic conductors in cylindrical holes in a stationary block of the same material (with a thin layer of mercury to give electrical contact), evidence was obtained of the existence of a critical velocity of rotation above which the system would be self-exciting. To reduce this critical velocity to an attainable value some inhomogeneity had to be introduced in the form of thin insulating layers. The behavior of the model in its steady-state self-exciting condition is described; large induced electric currents and magnetic fields were produced and appreciable power was dissipated as joule heating. Qualitative explanations are suggested, but the behavior is complicated by the saturation of the ferromagnetic conductor. Author

N64-33594 General Motors Corp., Santa Barbara, Calif. Engineering Physics Lab.
STUDY OF A THERMOPHOTOVOLTAIC CONVERTER Second Quarterly Progress Report, May 1–Aug. 31, 1963

Nov. 1963 44 p refs
(Contract DA-36-039-AMC-02255(E))
(TR-63-242; AD-424672)

Materials and components for a thermophotovoltaic converter were studied theoretically and experimentally. Germanium photovoltaic cells were tested at output power densities ranging up to 1.9 w/cm^2 under high illumination levels; grid design calculations were carried out on the basis of these measurements. Techniques were developed for mounting high-power-density optically aligned photocells on a cylindrical cooling jacket. Two semiconductor materials were examined as possible alternatives to germanium. Preliminary data are included on the reflectivity of emission enhancement coatings on a ceramic substrate; experiments were performed to determine the life of a new diffusion coating on a metallic substrate. Author

N64-33617* Livingston Electronic Corp., Montgomeryville, Pa.
DEVELOPMENT OF HIGH ENERGY DENSITY PRIMARY BATTERIES, 200 WATT HOURS PER POUND TOTAL BATTERY WEIGHT MINIMUM First Quarterly Report
Sandors G. Abens 30 Oct. 1964 47 p refs
(Contract NAS3-6004)
(NASA-CR-54118) OTS: $2.00 fs; $0.50 mf

The lower esters (methyl formate, ethyl formate, methyl acetate, ethyl acetate, n-butyl formate, butyl butyrate, and ethyl acetoacetate) were evaluated as possible electrolyte solvents for lithium-anode primary cells. Conductivity-concentration data with $LiClO_4$ electrolyte were obtained for five solvents. The highest conductivity was recorded for a 3.0-M solution of $LiClO_4$ in methyl formate, which had the value of 3.2×10^{-2} ohm^{-1} cm^{-1}. The stability of lithium metal in the esters and in solutions of $LiClO_4$ in the esters was studied. In testing cells having balanced theoretical electrode capacities, the system Li/CuF_2 with methyl formate–$LiClO_4$ electrolyte showed the best performance with respect to energy density, the highest figure obtained being 130-watt hours per pound at the 40-hour rate. The Li/MnO_2 showed ability to discharge after a 2-week open-circuit stand with butyrolactone-$LiClO_4$ electrolyte. P.V.E.

N64-33631* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POST IRRADIATION ROOM TEMPERATURE ELECTRICAL CHARACTERISTICS OF N/P SILICON SOLAR CELLS
Brian T. Cunningham and Ernest Moss Aug. 1964 25 p ref
(NASA-TM-X-55098; X-636-64-253) OTS: $1.00 fs; $0.50 mf

An engineering investigation, conducted to determine the postirradiation, room-temperature electrical characteristics of state-of-the-art, flight quality, and silicon N/P solar cells, is discussed. In particular, the results of a 1-MeV electron bombardment to a flux level of 10^{16} electrons/cm^2 conducted at, or near, room temperature, combined with a cursory examination of postirradiation annealing at elevated temperatures are presented. Conclusions drawn from the results include the following: (1) Solar-cell manufacturers are presently producing cells with a nominal 10% airmass zero efficiency. (2) The nominal 10-ohm-cm solar cell is decidedly more radiation resistant than the 1-ohm-cm cell at higher 1-MeV electron flux levels. (3) Changes in short-circuit current due to a postirradiation temperature treatment were definitely experienced in a limited experiment and can be as much as 5%. P.V.E.

N64-33715 IIT Research Inst., Chicago, Ill.
CHEMICAL CONVERSION OF HEAT TO ELECTRICAL ENERGY Final Report, 26 Dec. 1962–26 Dec. 1963
Ted M. Rymarz 11 Jul. 1964 39 p refs
(Contract NOw-63 0512-c)
(IITRI-C6006-10; AD-446642)

This program was concerned with the development of a system for the conversion of heat to electrical energy by means of a thermally regenerative galvanic cell. Cells 4 inches in diameter were constructed and tested that produced current densities of 18.9 mA/cm^2 and power densities of 6.7 mW/cm^3 (190 W/ft^3). Improvement of power densities to more than 5 kW/ft^3 appears feasible. Author

N64-33746 Sandia Corp., Albuquerque, N. Mex.
RE-ENTRY FLIGHT DEMONSTRATION NUMBER ONE (RFD-1): PREFLIGHT DISASSEMBLY ANALYSIS AND OBSERVED DISASSEMBLY OF THE SIMULATED SNAP-10A REACTOR
R. D. Klett, T. M. Hysinger, and M. M. Robertson Sep. 1964 124 p refs
(SC-RR-64-515) OTS: $2.50

The preflight analytical analysis included wind-tunnel tests, computer studies of the trajectory and of stagnation-point heating to determine local heating rates expected during the flight, and a computer analysis of reactor burnup. The computer studies were repeated after the flight test, using the actual atmospheric density and the observed trajectory. The results of the analytical studies are compared with the actual disassembly, as determined by optical, spectrographic, and telemetered data from the flight. Since there was good correlation between the analytical and the flight-test data, the disassembly of a simulated test reactor was predicted, assuming the flight unit had reentered on an orbital-decay trajectory at a zero-degree angle-of-attack. Author

N64-33751 Astra, Inc., Raleigh, N.C.
THE CASE FOR A SOLAR STEAM SPACE POWER SYSTEM
H. R. Kroeger 6 Jan. 1964 59 p refs
(ASTRA-846-6.1)

Results from four design cases are presented for a 20-ekW, solar, dynamic, space power system that uses steam as the working fluid, and orbits the earth at a distance of 250 n. mi. Author

N64-33756 Tyco Labs., Inc., Waltham, Mass.
ELECTROCHEMISTRY OF FUEL CELL ELECTRODES: SURFACE OXIDATION OF GOLD ELECTRODES Technical Memorandum No. 6
S. B. Brummer and A. C. Makrides Oct. 1963 27 p refs
(Contract Nonr-3765(00); ARPA Order 302-62)
(TM-6; AD-423991)

The surface oxides formed on electropolished gold by potentiostatic anodization in the range 1.2 to 1.8 V vs H^+/H_2 in the same solution have been studied by galvanostatic reduction at current densities between 10 and 1000 μA/cm^2. Molar perchlorate solutions of pH 0.04 to 2.1 were employed. The extent of oxide formation is determined by the potential of anodization, the charge increasing linearly with the potential of formation in the range of 1.4 to 1.8 V. Cathodic chronopotentiograms show that reduction of the oxide occurs at a definite potential that depends on the cathodic current density. Current-potential curves, constructed from the chronopotentiograms, follow a Tafel relation with a slope of 41 mV. The exchange current for oxide reduction decreases with pH and with increasing potential of formation of the oxide. The electrochemical order of the reduction reaction is −1.65 with respect to pH. Author

N64-33757 Tyco Labs., Inc., Waltham, Mass.
ELECTROCHEMISTRY OF FUEL CELLS ELECTRODES: HYDROGEN EVOLUTION AT DILUTE PLATINUM AND PALLADIUM AMALGAM ELECTRODES
James N. Butler and A. C. Makrides Oct. 1963 19 p refs
(Contract Nonr-3765(00); ARPA Order 302-62)
(TM-7; AD-423992)

The hydrogen overpotential and double-layer capacity of liquid amalgams containing 0.028 at.% platinum or 0.006 at.% palladium are identical with those for pure mercury. Triangular voltage sweep studies on the platinum amalgam give results identical with pure mercury, but the palladium amalgam shows behavior that may result from the formation of colloidal palladium or of a palladium–hydrogen complex on the surface. These results imply that electrocatalysis of the hydrogen reaction by these metals is a cooperative phenomenon, rather than an independently additive, atomic one. Author

N64-33764 Battelle Memorial Inst., Columbus, Ohio
COMPACT HEAT-EXCHANGER STUDY Final Technical Report, 1 Jul. 1963–31 Mar. 1964
F. A. Creswick, S. G. Talbert, and J. W. Bloemer 15 Jun. 1964 76 p refs
(Contract DA-44-009-AMC-313(X))
(AD-446233)

Heat-exchanger-performance data found in the literature are reduced to a form that allows compactness of core surfaces on the basis of geometrical configuration alone, by correcting for the influence of fluid properties and performance requirement parameters. Hydraulic radius of the core surface is shown to be the most important parameter affecting compactness. A compactness parameter is derived with which the required weight and volume of a heat exchanger for a given application may be estimated. Data and examples are given. Design studies were conducted to show the influence of hydraulic radius on the size and shape of a recuperator and precooler for a mobile, closed-cycle gas-turbine powerplant and to illustrate the usefulness and accuracy of the compactness parameter. Author

N64-33773* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
DEVELOPMENT OF PHOTOVOLTAIC STANDARD CELLS FOR NASA
D. W. Ritchie 1 Jun. 1964 18 p refs
(Contract NAS7-100)
(NASA-CR-59359; JPL-TR-32-634) OTS: $1.00 fs; $0.50 mf

The development of space-calibrated photovoltaic standard cells provides an accurate means of extrapolation of the short-circuit current of photovoltaic systems to space conditions. Photovoltaic standard cells have been obtained using both boron- and phosphorus-diffused silicon solar cells. The solar cells are directly correlated to standard cells flown to altitudes of 80 000 ft. The use of such standard cells allows the elimination of the pyrheliometer and "sky radiation" measurements required in the evaluation of solar cell arrays. The photovoltaic standard cells can be used to obtain the space solar energy equivalent of terrestrial sunlight or to calibrate solar simulators. Such photovoltaic standard cells have been used for the power prediction of the Ranger and Mariner solar cell arrays and provide an extrapolated air-mass zero value of short-circuit currents with accuracies better than 2%. Author

N64-33779* Duke U., Durham, N.C. Coll. of Engineering
RESEARCH ON SATELLITE ELECTRICAL POWER CONVERSION SYSTEMS AND CIRCUIT PROTECTION Fourth Semiannual Status Report, 1 May 1962–1 May 1963
Thomas G. Wilson 30 Jun. 1963 10 p
(Grant NsG-152-61)
(NASA-CR-50937) OTS: $1.00 fs; $0.50 mf

The status of work is reported for projects related to trigger circuits for controlled rectifiers, circuitry for controlling transient voltages and currents, the application of analog-computer techniques to the study of spacecraft electrical-system protection, nondissipative converter-regulators with short-circuit protection, switching transistors and silicon-controlled rectifiers, and low-voltage power conversion and regulation. D.E.W.

N64-33801* Astro Research Corp., Santa Barbara, Calif.
ROTARY, DEPLOYABLE SPACE SOLAR POWER SUPPLY
H. Schuerch and W. Robbins 22 Jul. 1964 87 p refs
(Contract NASw-652)
(NASA-CR-58760; ARC-R-153) OTS: $3.00 fs; $0.75 mf

A generic review of space operations points toward the desirability of large-sized, lightweight surfaces, capable of deployment and precise contour control and orientation in the space environment. Fresnel reflectors deployed by spin alone and maintained by spin in a precisely flat, circular disk that can provide high geometrical accuracy are investigated. Since no stiffness of the reflector is required or desired, it can be made very thin and hence very light. A passive heliotropic system, operating on solar radiation pressure, is proposed that is compatible with very lightweight, spin-stabilized construction. The use of a deployable, solid-state convective-heat-transport device in the form of a running belt system is investigated. Preliminary experiments of heat transfer in vacuum are made. Two sizes (15 and 150 kW) of rotary deployable space power supply are chosen to evaluate specific application of the above investigations. Author

N64-33804* Leesona Corp., Great Neck, N.Y.
THE IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS First Quarterly Report, 12 Jun.–12 Sep. 1964
[1964] 29 p refs
(Contract NAS5-3908)
(NASA-CR-59362) OTS: $2.00 fs; $0.50 mf

The study to date has comprised cathodic growth and anodic dissolution of zinc dendrites on flat sheet zinc electrodes held horizontally. All experiments have been performed at room temperature under potentiostatic conditions. Parameters varied were electrolyte and zincate concentrations, and the potential of the electrode during growth. The principal conclusion based on these experiments is that there is a definite progression in dendritic form from mossy to acicular (including intermediate modifications) as the potential of growth is made more cathodic to the experimental reversible potential of the zinc–zincate couple. This progressive modification is specifically a function of potential, rather than of the concentrations of electrolyte or zincate. Author

N64-33811* General Electric Co., Philadelphia, Pa. Missile and Space Div.
FUEL-CELL OXYGEN ANALYZER Preliminary Design Study
Robert G. Newland Dec. 1962 98 p refs
(Contract JPL-950286)
(NASA-CR-59363; PIR-7530-1419) OTS: $3.00 fs; $0.75 mf

Adaption of a fuel-cell-type oxygen analyzer design to the special requirements of determining the atmospheric oxygen response level on the planet Mars is discussed. As a result of the study, a fuel-cell oxygen analyzer assembly was fabricated that provided a voltage output change of 0.52 volts for an oxygen partial-pressure change from 0- to 10-mm Hg. A

rapid and reproducible response was demonstrated by the assembly when it was subjected to a series of tests simulating descent trajectories through the Mars atmosphere. A sample gas-flow rate of 25 cc/min at 113-mm Hg total pressure has been found to provide adequate sample gas for the oxygen analyzer. The analyzer assembly was fabricated from nonferrous materials to provide a nonoperating permanent magnetic field less than 1 gamma at 3 1/2 feet. P.V.E.

N64-33862 Naval Ordnance Lab., Corona, Calif. Research Dept.
AUTOMATIC TEST SET FOR AMMONIA RESERVE BATTERIES
Robert W. Yancey 15 Jun. 1964 26 p refs
(NAVWEPS-8195; AD-445855)

A description is given of the design and construction of a test set for automatically testing a four-section ammonia reserve battery. This test set provides a regulated prefire current to the activation mechanism followed by an activating signal of 20 V for 45 msec, measures the time required for all four battery sections to reach their respective specified voltages under the proper loads, and measures the noise voltage on a go, no-go basis for specified time intervals. Provisions also have been made for continuously recording the dc and noise voltages for each section. Author

N64-33886 Ion Physics Corp., Burlington, Mass.
ELECTROSTATIC POWER GENERATOR Quarterly Technical Progress Report, 15 Apr.–15 Jul. 1964
C. N. Coenraads [1964] 32 p
(Contract AF 33(615)-1168)
(QTPR-3; AD-603643)

The generator system has entered the testing stage. Seal testing is in its final stage, with satisfactory performance to 6000 rpm. The study of excitation methods for the generator was successfully terminated, and resulted in a design and a working-scale model. Included in the discussed progress are the following: (1) general seal and generator progress; (2) vacuum insulation—surface-hardness tests, pure-metal electrodes, pure-metal coatings, nonconducting coatings, and surface-finish studies; (3) crystal growth on electrodes; and (4) excitation transformers. P.V.E.

N64-33897* Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.
PNEUMATIC NUTATOR ACTUATOR MOTOR First Quarterly Report
C. N. High, G. R. Howland, and J. R. Williamson 30 Sep. 1964 61 p
(Contract NAS3-5214)
(NASA-CR-54204; BPAD-864-15521R) OTS: $3.00 fs; $0.75 mf

The high-torque, low-speed motor contains an integral transmission consisting of a pair of bevel gears, one of which is operated in a nutation motion by a number of pressurized bellows located around its periphery. Pneumatic flow is commutated to the power bellows by means of a number of vortex-type fluid interaction devices. Both mechanical and fluid state element designs were established. Tests were performed on components of the commutation circuit, the results of which are described. Based upon these tests, the dimensions of the power and selector vortex valves that form a major portion of the commutation circuiting were established. Fabrication status of all components is described. Author

N64-33901* Marquardt Corp., Van Nuys, Calif.
OPTIMIZATION STUDY OF MASS EXPULSION ATTITUDE CONTROL SYSTEMS BY MEANS OF ADVANCED LIMIT CYCLE TECHNIQUES
R. W. Adlhoch and W. C. Englehart 16 Oct. 1964 106 p refs
Its Rept.-6077
(Contract NAS8-11232)
(NASA-CR-59377) OTS: $4.00 fs; $0.75 mf

The method of evaluating the advanced limit-cycle control techniques is based on a three-axis thrusting cross-coupled error computer program. Feasibility of the control techniques was demonstrated by investigating the effects of various error sources for the specific conditions of interest. The general behavior of an attitude-control system is not only dependent on error values but also upon the nature of error distributions. A statistical survey of available test data was conducted to establish the error values and distributions. Three engine and vehicle configurations were analyzed with three different angular accelerations for each. Five control techniques were studied for each of these angular acceleration values. This study shows that the degree to which the mass expulsion system compares with alternate techniques depends on the performance of the torque-producing element and, to a greater extent, on the integration of this element in an overall control system. D.S.G.

N64-33918* Electric Storage Battery Co., Raleigh, N.C. Missile Battery Div.
RESEARCH AND DEVELOPMENT ON CELLS WITH BELLOWS CONTROLLED ELECTROLYTE LEVELS First Quarterly Report, 10 Jun.–10 Sep. 1964
F. S. Cushing and A. M. Chreitzberg [1964] 34 p refs
(Contract NAS5-3813)
(NASA-CR-59373) OTS: $2.00 fs; $0.50 mf

Preliminary Cd/KOH/NiOOH cell tests have verified that bellows action in a sealed cell can be used to flood the plates under low-pressure conditions to maximize discharge capacity and to drain the plates under high-pressure overcharge conditions to aid in gas recombination. A survey of commercially available metal bellows revealed that the ratio ($\Delta V/V$) of the volume change (ΔV) between conditions of maximum extension (lowest pressure) and maximum contraction (highest pressure) to the rectangular volume (V) required for installation in a sealed cell does not now exceed 0.4. Plastic pillows, partially inflated with air, and sealed within the cell are proposed as bellows substitutes. The pillow $\Delta V/V$ value is approximately twice the present bellows volume efficiency. Author

N64-33968 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio
AN AUTOMATIC FLIGHT CONTROL SYSTEM TO SIMULATE SUB-EARTH GRAVITY ENVIRONMENT IN THE KC-135 AIRCRAFT
Robert Williamson Kennedy (M.S. Thesis) Jun. 1964 118 p refs
(GGC/EE/64-13; AD-603952)

The purpose of this problem was to design an automatic flight-control system capable of simulating zero-, Moon-, or Mars-gravity environment (±0.005 g) in the zero-g KC-135. The problem analysis consists of a mathematical investigation of the simulation of gravity environments with maneuvering aircraft. The system is designed by the use of root locus techniques and analog computer simulation. The analog simulation is used to evaluate the system, and the system succeeds in

simulating the desired gravity environments within the required tolerances for periods greater than 12 seconds per maneuver.
Author

N64-33979 Lockheed Missiles and Space Co., Sunnyvale, Calif. Electrochemistry Materials Sciences Lab.
LITHIUM-SILVER CHLORIDE SECONDARY BATTERY INVESTIGATION Quarterly Technical Progress Report
J. E. Chilton, Jr., W. J. Conner, and R. W. Holsinger 14 Jul. 1964 26 p
(Contract AF 33(615)-1195)
(QTPR-2; AD-450428)

Aluminum cases for housing the lithium–silver chloride nonaqueous electrolyte cell system were prepared using an improved seal-assembly technique. Propylene carbonate electrolyte conductivity may be increased by the addition of solvents such as ether and toluene. The electrodeposition of propylene lithium from 50-volume-percent solutions of these solvents with propylene carbonate LiCl and $AlCl_3$ occurs at high efficiency. Lithium electrode deposition occurs with high efficiencies from propylene carbonate solutions with lithium perchlorate, bromide, or chloroaluminate salts. A method of preparation of silver chloride electrodes is given. The total chloride ion content of the propylene carbonate electrolyte was determined by nonaqueous potentiometric titration with silver perchlorate.
D.E.W.

N64-33999* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
SUNFLOWER I CONDENSER-SUBCOOLER Topical Report, Jun. 1960–Aug. 1962
J. A. Heller 1 Jun. 1964 53 p refs
(Contract NAS5-462)
(NASA-CR-54013; ER-5088) OTS: $3.00 fs; $0.50 mf

This report includes the initial analytical investigations necessary to establish the fluid-dynamic design criteria for a mercury condenser capable of sustaining operation in a gravity field of zero to 1 g in any direction. The effects of vapor velocity and gravity vector on drop size, drop acceleration, and drop velocity were specifically examined. The results of the analyses, together with their experimental verification, are included. The correlation used for the two-phase condensing pressure drop prediction and the methods of interface maintenance capable of operating under the system acceleration requirement were also experimentally investigated. A modification of the conventional meteoroid protection model was developed and applied toward system armor. The first condenser-subcooler design, based on these analytical and experimental investigations, is presented. The results and analysis of the full-scale component test are discussed.
Author

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-32751 General Electric Co., Schenectady, N.Y. Research Lab.
RESEARCH OF DIELECTRIC MATERIALS Technical Documentary Report, 15 Jan. 1963–15 Jan. 1964
J. C. Devins, H. L. Greenhaus, R. J. Wolff, D. R. Johnston, F. F. Carini et al Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 143 p refs
(Contract AF-33(657)-8825)
(ML-TDR-64-57; AD-602438) OTS: $5.00

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N64-32752 General Electric Co., Schenectady, N.Y. Research Lab.
IONIZATION AND ELECTRON ATTACHMENT IN GASES, PHASE I. PART A: NEGATIVE ION MASS SPECTROMETRY
H. L. Greenhaus *In its* Res. on Dielectric Mater. May 1964 p 1–33 ref (See N64-32751 24-07) OTS: $5.00

Discussed is the elucidation of electron impact processes in electronegative perfluorocarbons, by the use of negative and positive ion mass spectrometry, and the correlation of these processes with molecular structure. The negative ions formed in C_3F_8 and C_4F_{10} by electron impact was studied. The energy dependence of the cross sections for formation of F^-, CF_3^-, and $C_2F_5^-$ in perfluoropropane were determined, along with the appearance potentials for the negative ions formed in C_2F_6 and C_4F_{10}. The positive-ion spectrum of perfluorobutane showed the presence of the parent molecular ion $C_4F_{10}^+$. The C-F bond dissociation in C_4F_{10} calculated from the approximate appearance function of the F^- ion [$A(F^-) = 1.6$ eV] was found to be 120 kcal. The positive ion spectrum of a purified isomeric C_6F_{14} mixture showed less than 1% cyclo-C_6F_{12}. No parent negative ions were observed in CF_4, C_2F_6, or C_3F_8.
P.V.E.

N64-32753 General Electric Co., Schenectady, N.Y. Research Lab.
IONIZATION AND ELECTRON ATTACHMENT IN GASES, PHASE 1. PART B: IONIZATION AND ATTACHMENT COEFFICIENTS
J. C. Devins and R. J. Wolff *In its* Res. on Dielectric Mater. May 1964 p 35–78 refs (See N64-32751 24-07)
(Contract AF 33(616)-7485) OTS: $5.00

Measurements of ionization and attachment coefficients were made on five normal perfluoroalkanes—CF_4, C_2F_6, C_3F_8, C_4F_{10}, and C_5F_{12}, and also on cyclic C_4F_8, the olefin C_3F_6, and t-C_4H_9Cl. The "composite" cross section for electron scattering obtained from ionization coefficients are linear functions of the number of carbon–fluorine bonds or fluorine atoms in the molecules. A comparison of measured sparking potentials and those calculated from ionization coefficients showed good agreement for all the gases except C_4F_{10}. The dependence of η/p (attachment coefficient/pressure) on pressure for C_4F_{10} is explained in terms of a metastable parent

negative ion that can be stabilized by collision. For all the gases except C_3F_6, η/p decreases with increasing E/p (E being the superimposed field). Values of η/p were not obviously related to the geometric cross sections. A semiquantitative correlation between attachment cross sections measured in the mass spectrometer and η/p was found for the perfluoroalkanes, and the processes responsible for attachment were identified. P.V.E.

N64-32754 General Electric Co., Schenectady, N.Y. Research Lab.
CHEMICAL EFFECTS OF CORONA ON MATERIALS, PHASE II. PART A: STUDIES OF CORONA DAMAGE TO MATERIALS USING POSITIVE AND NEGATIVE D-C DISCHARGES
F. F. Carini, D. R. Johnston, and A. Pletenik *In its* Res. on Dielectric Mater. May 1964 p 79–90 (See N64-32751 24-07) OTS: $5.00

A study of corona damage to materials (insulators) is discussed with respect to two cases: bombardment when the insulation is the anode, and bombardment when the insulation is the cathode. Differences between materials and the differences due to different kinds of discharges are considered. Stearyl alcohol and eicosane were investigated, along with Townsend-like and streamerlike discharges on dotricontane. P.V.E.

N64-32822 Purdue U., Lafayette, Ind.
CHEMISTRY OF FERROCENE AND RELATED COMPOUNDS Final Report
Robert A. Benkeser Jan. 1963 16 p
(Contract AF 49(638)-297)
(AD-600969)

There were four primary objectives in this research project: (1) A series of ferrocene compounds containing a carboxyl group in one of the rings and a variety of other electron supplying and withdrawing groups in the other ring were synthesized. (2) Free radical addition reactions to the vinylferrocene group in view of obtaining new types of ferrocene compounds were studied and demonstrated by equations. (3) Methods of decomposing substituted ferrocenes into their present cyclopentadienes with the principal purpose of working out a method for identifying new ferrocene structures were discussed. (4) A study was made of the metalation of various alkylferrocenes with *n*-amylsodium. A competitive metalation between ferrocene and benzene was carried out with a limited amount of *n*-amylsodium. E.C.

N64-32826 Mound Lab., Miamisburg, Ohio
MOUND LABORATORY PROGRESS REPORT FOR JULY 1963
J. F. Eichelberger, G. R. Grove, and L. V. Jones 30 Jul. 1963 24 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1170)

Basic and applied research was carried out on the following radioelements: Thallium-204 Half-life; Polonium-208–209 Decay Scheme studies; Actinium-227 Separation; Thorium-228 Half-life; Uranium-234 Separation and Analysis. Isotope separation studies of carbon-13 are presented. The use of alternating current for heating thermal diffusion column wires is discussed. Neutron measurements and polonium alpha sources and fabricating techniques are given. Methods of analyzing elements and compounds, such as low-level krypton counting and four pi beta counters, are described. E.C.

N64-32827 Mound Lab., Miamisburg, Ohio
MOUND LABORATORY PROGRESS REPORT, MAY 1964
J. F. Eichelberger, G. R. Grove, and L. V. Jones 4 Sep. 1964 23 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1203)

This report contains the following studies: Uranium-234 Separation and Purification; Neutron Measurements—Gauss' quadrature formula, and neutron yields of PoBe sources: Helium-3—feed-gas purification, vapor-pressure thermometry, and superfluid experiment; Argon Isotope Separation; Xenon Isotope Separation and Purification—thermal diffusion, experimental chromatograph, and xenon-tube bundle; Thermal Diffusion Research—center wire heating by alternating current; Carbon Isotope Separation—thermal diffusion and conversion of enriched methane to barium carbonate; Conductive Adhesives; Low-Level Krypton-85 Counting; and Actinium-227 Separation. G.G.

N64-32843 Joint Publications Research Service, Washington, D.C.
THE ELECTROCHEMICAL OXIDATION OF BARRIER-LAYER METALS
I. S. Zhukova and L. L. Odynets *In its* Phys. of Semiconductors and Metals Oct. 1964 p 4–20 refs (See N64-32842 24-18) OTS: $3.00

The authors found that, to give a comprehensive description of the mechanism involved in electrochemical oxidation, it is apparently necessary to consider all the possible processes and their actions simultaneously. The essential role of the complex structure of the oxide layer itself must be emphasized, and, if the representation of the oxide film in the electrolyte as a complicated microgalvanic system is to be repeated, then it will be impossible to construct any definitive theory of the electrochemical oxidation of the barrier-layer metals. A.W.

N64-32861 Ozark-Mahoning Co., Tulsa, Okla.
SYNTHESIS OF NEW FLUORINE CONTAINING COMPOUNDS Quarterly Technical Summary, 1 Jul.–30 Sep. 1964
J. B. Beal, Jr. and C. Pupp 9 Oct. 1964 9 p refs
(Contract AF 04(611)-9556; ARPA Order 24)
(AD-449477)

Experimental work consisted of the following: (1) Reactions of nitrous oxide, nitric oxide, dinitrogen trioxide, and nitrogen dioxide with cesium fluoride suspended in acetonitrile; (2) reaction of fluoride with sodium hyponitrite; (3) electrolysis of molten salts; and (4) reactions of nitrosyl and nitryl fluorides with cesium fluoride. Author

N64-32879 Suffield Experimental Station, Ralston, Alberta (Canada)
AN IMPROVED FRACTION COLLECTOR FOR THE DISTILLATION AND SUBSEQUENT HANDLING OF AIR AND/OR MOISTURE SENSITIVE COMPOUNDS
J. P. Bitz 11 Mar. 1964 6 p refs
(Suffield-TN-128)

A convenient fraction collector for the distillation and subsequent handling compounds sensitive to atmospheric oxygen and/or moisture is described. It is designed so that fractions are collected by distillation in sample tubes that can be stoppered in situ under an inert atmosphere. The apparatus has been used successfully in purifications of V- and G-agents. Author

N64-32884 Joint Publications Research Service, Washington, D.C.

PRODUCTION AND PROPERTIES OF RARE EARTH ELEMENTS

13 Oct. 1964 50 p refs Transl. into ENGLISH of 2 Articles from the book "Redkozemel'nyye Elementy" Moscow, Inst. of Geochem. and Anal. Chem., Akad. Nauk SSSR, 1963
(JPRS-26877; TT-64-51134) OTS: $2.00

CONTENTS:

1. PRODUCTION AND PHYSICAL-CHEMICAL PROPERTIES OF RARE EARTH CARBIDES AND NITRIDES G. V. Samsonov, T. Ya. Kosolapova, M. D. Lyutaya, and G. N. Makarenko p 1–24 refs

2. PRODUCTION AND PROPERTIES OF SILICIDES OF SOME RARE EARTH ELEMENTS G. V. Samsonov, V. S. Neshpor, and Yu. B. Paderno p 25–47 refs

N64-32892* Georgia Inst. of Tech., Atlanta Engineering Experiment Station

CHEMICAL REACTIVITY OF HYDROGEN, NITROGEN AND OXYGEN ATOMS AT TEMPERATURES BELOW 100°K Third Semiannual Technical Report

H. A. McGee, Jr., D. B. Bivens, T. J. Malone, W. J. Martin, and J. H. Wilson 15 Jul. 1964 23 p refs
(Grant NsG-337; Proj. A-661)
(NASA-CR-58968) OTS: $1.00 fs; $0.50 mf

This report contains a restudy of and expansions upon earlier observations of chemical reactivity at cyrogenic temperatures. The following systems of study are based on considerations from space chemistry: "Ionization and Appearance Potential Measurements"; "Cryogenic Purification and Mass Spectrometer Inlet System"; "Preparation of Diatomic Species of the Alkali Metals"; "Reactions of Atomic Hydrogen"; and "Furnace Beam Inlet System." G.G.

N64-32899 France. Ministere de l'Air, Paris

CONTRIBUTION TO THE STUDY OF CONDENSATION OF α ETHYLENIC KETONES IN A BASIC HOMOGENEOUS OR HETEROGENEOUS MEDIUM [CONTRIBUTION A L'ETUDE DE LA CONDENSATION DES CETONES α ETHYLENIQUES EN MILIEU BASIQUE HOMOGENE OU HETEROGENE]

Bernard Furth Serv. de Doc. Sci. et tech. de l'Armement, Jun. 1964 97 p refs In FRENCH *Its* Publ. Sci. et Tech. Notes Tech. No. 138

Studies of the reactivity of unsaturated conjugated α-ethylenic ketones and of the selectivity of the condensation in the presence of different basic catalysts (MgO, BaO, alkali alcoholates, anion exchangers, quaternary ammonium salts, and lithium) are reported. Vapor-phase chromatography was used to establish the isomers of dimerization, and structural analyses were performed by infrared, ultraviolet, and nuclear-magnetic-resonance spectrometry. Trans. by M.P.G.

N64-32946 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering

A TWO ELECTRODE ELECTROCHEMCIAL SENSOR FOR DETECTING TRACE PROPELLANTS IN AIR

Paul C. Mc Lellan, Jr. (M.S. Thesis) Aug. 1963 70 p refs
(GE/EE/63-19; AD-419994)

The accurate detection of UDMH to its threshold limit value is achieved with a two-electrode-electrochemical sensor and a KI electrolyte. Three electrolytes are tested with two cells to realize this detector. The theory of electrochemical reactions in solutions is valid for this sensor, and the large capacitance is explained by the electric double-layer concept. An equivalent electrical model is derived to optimize sensor response. A flow system and standard measuring instruments are used to obtain the experimental results. The electrochemical reaction between the cell and UDMH results in a decrease of overvoltage in proportion to the concentration of UDMH in air. Finally, a linear approximation of this reaction is obtained with a UDMH equivalent circuit. Author

N64-32961 Rice U., Houston, Tex.

OPTICAL SPECTRA AND MOLECULAR PARAMETERS OF LIGHT ELEMENT MOLECULES Progress Report No. 5, 1 Apr.–30 Jun. 1964

John L. Margrave [1964] 5 p refs
(Contract DA-31-124-ARO(D)-91; ARPA Order 40)
(PR-5; AD-445625)

For the visible and near ultraviolet spectroscopy of halides in the rf plasma torch, borontrifluoride, carbontetrafluoride, and silicontetrafluoride were injected into the argon plasma, and spectra from different sections of the luminous flame up to 6 in. below the discharge region were photographed. A fast pumping system for spectral studies from gaseous fluorides and other related halides was constructed. Mass spectral studies of nickelfluoride, manganesefluoride, and manganesefluor have been completed, the heats of nickelfluoride and manganesefluoride sublimation were determined, and the bond energy of manganesefluor was obtained. G.G.

N64-32962 IIT Research Inst., Chicago, Ill. Technology Center

OPTICAL SPECTRA OF SOME LOW-MOLECULAR-WEIGHT COMPOUNDS USING THE MATRIX ISOLATION TECHNIQUE Quarterly Technical Summary Report, 14 May–14 Aug. 1964

Alan Snelson [1964] 16 p
(Contract DA-31-124-ARO(D)-111; ARPA Order 458)
(IITRI-C6013-5; AD-432758)

This report covers the spectroscopic determination of thermodynamic functions of low-molecular-weight compounds formed in the exhaust gases of rocket motors. The infrared spectra of calcium, strontium, and barium fluoride were determined by use of the matrix isolation technique. The infrared spectra of calcium and strontium fluoride are interpreted in terms of a linear molecular configuration, but the infrared spectrum of barium fluoride did not permit a definite geometric interpretation. G.G.

N64-32967 IIT Research Inst., Chicago, Ill. Technology Center

RESEARCH ON CHEMISTRY OF O_3F_2 AND O_2F_2 Technical Summary Report, 1 Jan.–30 Jun. 1964

Irvine J. Solomon 1 Sep. 1964 24 p refs
(Contract AF 49(638)-1175)
(IITRI-C227-7; IITRI-C227-8; AD-449383)

Research dealing with the following objectives is discussed: (1) the elucidation of the chemistry of O_3F_2 and O_2F_2 with inorganic compounds; (2) the study of the physical properties of O_4F_2 as a means of revealing the presence or absence of ionic species in O_4F_2; (3) the determination of the oxidizing species remaining in solution after fluorination of nitric acid; and (4) the determination of the feasibility of preparing new ions of the type NF_4^+ and $NH_2F_2^+$. The work is summarized under the following headings: (1) the NF_4^+, $N_2F_5^+$, and $H_2NF_2^+$ ions—difluoramine additives (hydrogen chloride, sulfur trioxide, trimethyl aluminum, and trimethyl gallium), methyl difluoramine additives, and dimethyl fluoramine additives; (2) physical properties of O_4F_2; (3) reactions of O_2F_2—disodiumperoxydicarbonate, and sulfur oxides and oxyfluorides; and (4) chemistry of O_3F_2. P.V.E.

N64-32980 Technische Hochschule in Graz (Austria)
STUDIES OF PREPARATION AND PROPERTIES OF ACTIVE ALKALI AZIDES AND BARIUM AZIDE AND EFFECTS OF THIS ACTIVITY ON THERMODYNAMIC AND THERMOCHEMICAL DATA Monthly Technical Status Report No. 3, 1–31 Aug. 1964
Karl Torkar 11 Sep. 1964 7 p
(Contract DA-91-591-EUC-3320)
(AD-448342)

In studying the dehydration behavior of bariumazide-monohydrate, the aspects considered included X-ray examination, thermogravimetery, dynamic-differential calorimetry, equilibrium pressures, heats of solution, and enthalpies of formation. The monohydrate was found to be a stable substance in relation to the water-free bariumazide. The rate of dehydration of the monohydrate depends strongly on the water-vapor pressure of the used atmosphere in the reaction course, on the particle size of the preparation, and on the heating rate. R.L.K.

N64-32982 Hercules Powder Co., Wilmington, Del. Hercules Research Center
A STUDY OF THE ELECTRONIC CONFIGURATION AND BEHAVIOR OF THE $-NF_2$ GROUP Quarterly Report No. 6, Jun.–Sep. 1964
A. D. Craig and R. S. Voris 21 Sep. 1964 77 p refs
(Contract DA-31-124-ARO(D)-62; ARPA Order 402)
(HRC-64-4; AD-448367)

Research is reported as follows: (1) electrochemistry of N-F compounds, especially the effect of the supporting electrolyte on the reduction mechanism of HNF_2 in aprotic systems, the determination that the reduction product is NH_3 with fluorine accounted for as F^-, and studies of reduction of NF_3; (2) solvation of HNF_2, including enthalpies of dissociation, strength of solvation complexes, and site of hydrogen bonding; (3) mass spectrometry of N—F compounds CH_3NF_2 and CF_3NF_2, indicating that the C—N bond is stronger in the former and the N—F bond is stronger in the latter; and (4) theoretical calculations of the molecular integrals (nn;nn), (ff;ff), (nn;ff), (N;nf), (N;ff), (F;nn), and (F;fn) as a function of internuclear separation and calculations of electron transitions of CF_3NF_2 and CH_3NF_2. M.P.G.

N64-33013 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
CHEMISTRY OF URANIUM AND TRANSURANIUM ELEMENTS
V. D. Vdovenko Sep. 1960 737 p refs Transl. into ENGLISH of the book "Khimiya Urana Transuranovykh Elementov" Moscow, Izd. Akad. Nauk SSSR, 1960 737 p
(AEC-TR-6421) OTS: $7.50

The basic data on the chemical and physical properties of uranium and the transuranic elements are presented, and the most important compounds and methods of production are described. Particular attention has been given to the radiochemical properties and to the chemical principles of treating irradiated fuel elements. This book contains the following chapters: "The Chemistry of Uranium"; "The Chemistry of the Transuranic Elements"—neptunium, plutonium, americium, curium, the transcurium elements, and the magnetochemistry of thorium, uranium, and the transuranic elements; and "The Scientific Principles of the Chemistry of Fuel Processing." G.G.

N64-33018 Bureau of Mines, Amarillo, Tex. Helium Research Center
AN APPARATUS FOR DETERMINING THE HELIUM CONTENT OF GAS MIXTURES
Ellis M. Frost, C. G. Kirkland, and D. E. Emerson 1964 22 p
(BM-RI-6545)

An apparatus has been developed for determining the helium content of gases containing 40% or more helium. It utilizes activated coconut charcoal at liquid nitrogen temperatures to adsorb constituents other than helium in the mixture. Series of analyses have been run where the mean deviation was less than 0.05% helium. Twenty or more analyses can be made in an 8-hour day. Author

N64-33026 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CATALYSIS OF REACTIONS IN SOLID PHASE
F. Shol'moshi and L. Reves 12 Feb. 1964 21 p refs Transl. into ENGLISH from Kinetika i Kataliz (USSR), v. 4, no. 1, 1963 p 88–96
(FTD-MT-63-244; AD-605590)

The catalytical action of ferric oxide on different stages of disintegration of ammonium perchlorate, and also disintegration of pure ammonium perchlorate in the same conditions are studied. The addition of ferric oxide at 210° to 240° C hardly affected the course of the reaction, but at 245° to 270° C rendered significant catalytic action. Analysis of kinetic data leads to the conclusion that ferric oxide promotes acceleration of the transmission of electrons from anions to cations, which is the controlling stage of the reaction. Ferric oxide also catalyzed the reaction of ammonium perchlorate at high temperature. Author

N64-33030 Oklahoma State U. Research Foundation, Stillwater
THERMODYNAMIC PROPERTIES OF ZIRCONIUM AND HAFNIUM HALIDES Quarterly Progress Report, 23 Jan.–23 Apr. 1964
Robert D. Freeman, P. D. Gwinup, and W. C. Parks 4 May 1964 8 p refs
(Contract AF 33(615)-1449)
(QPR-1; AD-449608)

Differential thermal analysis–differential scanning calorimetry is suggested as a technique for obtaining valid data for the disproportionation of $ZrCl_3$. Progress in attempts to prepare $ZrCl_3$ and in developing and testing a reaction calorimeter is reported. Author

N64-33035* Aero Vac Corp., Troy, N.Y.
EFFECT OF LOW DENSITY INERT GAS FLUSH ON OXYGEN–COLUMBIUM REACTION AT 1500°F TO 2000°F First Quarter Report
14 Aug. 1964 7 p
(Contract NASw-722)
(NASA-CR-59004) OTS: $1.00 fs; $0.50 mf

Future plans are stated, and progress in application of the gas purge process is described. The mass-spectrometer system design is presented, and its operation is outlined. Columbium samples were exposed to an oxygen–argon mixture at temperatures from 1500° to 2000° F, and results of ensuing tests for weight gain, oxygen analysis, and hardness are tabulated. D.E.W.

N64-33048* Adelphi U., Garden City, N.Y.
[MULTIDISCIPLINARY SPACE-RELATED SCIENCES AND TECHNOLOGY] Interim Report, 18 Nov. 1963–15 Jun. 1964
[1964] 13 p refs
(Grant NsG-394)
(NASA-CR-58839) OTS: $1.00 fs; $0.50 mf

This report contains brief papers on the progress in the following projects: "Collision Processes in Gases"; "Magnetic Susceptibility and Magneto Thermal Oscillations in Beryllium"; "Reactions with 3-Buten-1-01 and Phenethyl Alcohol"; "Determination of Single-Ion Activity Coefficients by Buffer Capacity Measurements"; "Hydrogen Bond Investigations"; "Effects of Varying Physical Parameters on Post-Irradiated Bacterial Cells"; and "Study of Interrelationships between the Physical, Chemical, and Biological Components of an Estuarine System." A.W.

N64-33065 Los Alamos Scientific Lab., N. Mex.
ELECTRON MICROPROBE EXAMINATION OF DELTA-STABILIZED PLUTONIUM
E. A. Hakkila, G. R. Waterbury, and C. F. Metz 9 Oct. 1964 15 p refs
(Contract W-7405-ENG-36)
(LA-3125) OTS: $0.50

An electron microprobe method was developed for determining the gallium in plutonium stabilized in the delta phase with 0.1% to 2% of gallium. Samples are metallographically polished, then ultrasonically cleaned to remove loose particles of plutonium-containing material. Intensities of the Kα X-ray line for gallium, corrected for background, are measured from randomly selected areas of the sample and are compared to intensities measured from pure gallium and a known, homogeneous plutonium–1% gallium alloy. The standard deviation of the method is 0.03% and 0.04% for analyzing samples containing 0.00% and 1.00% of gallium, respectively. Author

N64-33066 Los Alamos Scientific Lab., N. Mex.
THE DETERMINATION OF SILICON IN PLUTONIUM METAL AND ALLOYS USING PERCHLORIC ACID DEHYDRATION
Arthur L. Henicksman, Charles T. Apel, William H. Ashley, and Al Zerwekh 12 Oct. 1964 12 p refs
(Contract W-7405-ENG-36)
(LA-3134) OTS: $0.50

The classical gravimetric method for the determination of silicon, using perchloric acid as the dehydrating agent, has been modified and applied to the determination of silicon in plutonium metal, plutonium silicide, and various plutonium alloys. The sample is dissolved in hydrochloric acid, and the silica is dehydrated by fuming with perchloric acid. After filtering, the silica is ignited and weighed. After treatment with hydrofluoric acid, the residue is weighed, and the loss in weight corresponds to the amount of silica present in the sample. The method has been applied to known mixtures simulating alloys containing silica in amounts from 0.1% to 5.0%. The average recovery of the silicon present ranged from about 99% in the mixtures high in silicon to about 96% in the samples containing the smallest amounts. Author

N64-33130 Army Materiel Command, Washington, D.C.
PROPERTIES OF EXPLOSIVES OF MILITARY INTEREST, SECTION 1 Engineering Design Handbook
W. R. Tomlinson, Jr., comp. Aug. 1963 297 p refs
(AMCP-706-177)

This is predominantly a report of standard tests with a compilation of data on properties of explosives. It contains tabulated data of tests on 83 explosive components or mixtures, and covers sensitivity to friction, impact, and heat; performance or effectiveness in weapons; physical and chemical properties; method of preparation, synthesis, or manufacture; and supplementary references. G.G.

N64-33132 Army Materiel Command, Washington, D.C.
MILITARY PYROTECHNICS SERIES. PART THREE—PROPERTIES OF MATERIALS USED IN PYROTECHNIC COMPOSITIONS Engineering Design Handbook
Oct. 1963 354 p refs
(AMCP-706-187)

This presentation of the principal ingredients of pyrotechnic compositions is on data sheets and covers a total of 128 ingredients. A single reference list, showing the main sources of data, is included. G.G.

N64-33139 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
PROCEEDINGS OF THE NINTH ANNUAL CONFERENCE ON BIO-ASSAY AND ANALYTICAL CHEMISTRY, OCTOBER 10 AND 11, 1963, SAN DIEGO, CALIFORNIA
[1963] 242 p refs Conf. Sponsored by Gen. Dyn. Corp.
(TID-7696) OTS: $2.50

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1. BERYLLIUM SMEAR SAMPLING—IS IT USEFUL? John Zdanowicz (Pratt and Whitney Aricraft) p 1–9 refs

2. THE DETERMINATION OF TECHNETIUM-99 IN URINE William Fairman and Jacob Sedlet (Argonne Natl. Lab.) p 10–31 refs

3. ABSORPTION OF URANIUM ALPHA PARTICLES BY WHATMAN NO. 41 FILTER PAPER Michael W. Boback (National Lead Co. of Ohio) p 32–36 refs

4. DETERMINATION OF PLUTONIUM IN URINE BY ANION EXCHANGE Evan E. Campbell and William D. Moss (Los Alamos Scientific Lab.) p 37–52 refs

5. PAPER CHROMATOGRAPHY APPLIED TO RADIOLOGICAL CHEMISTRY George A. Welford, Elias L. Chiotis, John S. Alercio, and Robert S. Morse (AEC, New York) p 53–63

6. URINALYSIS FOR METABOLIZED PLUTONIUM W. E. Sheehan, W. R. Wood, Jr., and H. W. Kirby (Monsanto Res. Corp.) p 64–86 refs

7. GRAPHICAL RESOLVING OF GAMMA SPECTRA N. A. Halliden and J. H. Harley (AEC, New York) p 87–100

8. FIELD SPECTROMETRY OF ENVIRONMENTAL GAMMA RADIATION Wayne M. Lowder, Harold L. Beck, William J. Condon (AEC, New York) p 101–110 refs

9. DETERMINATION OF THE AVERAGE CS-137 BODY BURDEN IN A POPULATION BY URINALYSIS H. E. Palmer (Hanford Labs.) p 111–119 refs

10. EXCRETION OF STRONTIUM-90 FOLLOWING ACCIDENTAL INHALATION W. L. Fisher and R. F. G. Kellehar (Atomics International) p 120–139 refs

11. OBSERVED EFFECTS OF PLUTONIUM IN WOUNDS OVER A LONG PERIOD OF TIME S. E. Hammond and E. A. Putzier (Dow Chemical Co.) p 140–165 refs

12. ELIMINATION AND DEPOSITION OF ENRICHED URANIUM FOLLOWING ACUTE ACCIDENTAL INHALATION Jacob Sedlet and Jean J. Robinson (Argonne Natl. Lab.) p 166–180 refs

13. A CONTINUED PROGRAM OF ANALYSIS FOR URANIUM IN HUMAN AND ANIMAL TISSUES Richard C. Heatherton, Michael W. Boback, and Joseph A. Quigley (Natl. Lead Co. of Ohio) p 181–191 refs

14. INFLUENCE OF AEROSOL PROPERTIES AND THE RESPIRATORY PATTERN UPON HAZARDS EVALUATION FOLLOWING INHALATION EXPOSURE Robert G. Thomas (Lovelace Foundation for Medical Education and Research) p 192–231 refs

15. THE ANALYSIS OF LOW LEVELS OF URANIUM IN WATER AND URINE L. A. Currie, G. M. France, III, and P. Mullen (Natl. Bureau of Standards) p 232

16. DETERMINATION OF ACTINIDES IN URINE BY LIQUID ION EXCHANGE F. E. Butler (Du Pont de Nemours (E.I.) and Co.) p 233

17. IN VITRO METHODS OF ESTIMATING RELATIVE SOLUBILITY IN BODY FLUIDS G. W. Royster, Jr., B. R. Fish and L. B. Farabee (Oak Ridge Nat. Lab.) p 234

18. A FEEDING EXPERIMENT TO DETERMINE THE PARAMETERS OF RETENTION AND EXCRETION OF RADIUM IN MAN J. J. Gabay (New York State Dept. of Health) p 235

19. AN IN VIVO STUDY ON THE EFFECT OF NATURAL CHELATES IN CATTLE FEED ADDITIVES N. I. Sax (New York State Dept. of Health) p 236

N64-33161* Aerojet-General Corp., Azusa, Calif. Chemical Products Div.

RESEARCH ON PROCESSES FOR UTILIZATION OF LUNAR RESOURCES Summary Report, 16 Nov. 1963–15 Jul. 1964

S. D. Rosenberg, G. A. Guter, and F. E. Miller Aug. 1964 73 p refs *Its* Rept.-2895

(Contract NAS7-225)

(NASA-CR-59197) OTS: $3.00 fs; $1.75 mf

Laboratory apparatus for studying the reduction of igneous rock with carbon, hydrogen, and methane was designed, fabricated, and operated. Several experiments demonstrated that with the use of specially designed inlet tubes, methane reacts with silicate materials at 1600° C to form carbon monoxide, hydrogen, silicon, carbon, and slag. Quantitative recovery of carbon was achieved. Reactor materials were found that allow the reaction to run at 1600° C for long time periods. Author

N64-33167* Rensselaer Polytechnic Inst., Troy, N.Y.

INFRARED AND PROTON NMR STUDIES OF METALLIC ACETATE COMPLEXES

Kent J. Eisentraut Feb. 1964 196 p refs

(Grant NsG-100-60)

(NASA-CR-59032) OTS: $5.00 fs; $1.25 mf

This study is concerned with the infrared absorption of the coordinated water molecules that are present in the hydrated complexes. Integrated proton nuclear-magnetic-resonance spectra have been obtained in order to determine the number of coordinated water molecules present per molecule acetate. The spectra of the anhydrous, dehydrated, hydrated, and deuterated hydrates are compared at room temperature and at liquid-nitrogen temperature from 2.5 to 40 microns, in an effort to assign all vibrations of the coordinated water molecules. In a few cases, infrared analysis was compared with X-ray structures of hydrated acetate complexes. E.C.

N64-33197* Pennsylvania U., Philadelphia Electrochemistry Lab.

STUDIES OF THE FUNDAMENTAL CHEMISTRY, PROPERTIES, AND BEHAVIOR OF FUEL CELLS Semiannual Progress Report, 1 Oct. 1963–31 Mar. 1964

John O'M. Bockris [1964] 150 p refs

(Grant NsG-325)

(NASA-CR-59094) OTS: $4.00 fs; $1.00 mf

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2. ELECTROCATALYSIS 2 p refs
3. CATALYTIC ACTIVITY FOR SIMPLE ELECTRODE REACTION 6 p refs
4. DEACTIVATION OF ELECTRODES 7 p refs
5. MODEL POROUS ELECTRODE 1 p refs
   - A. DESIGN OF POTENTIOSTAT 6 p refs
   - B. EXPERIMENT AND RESULTS 4 p refs
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APPENDIX I

7. ELECTROCHEMICAL CATALYSIS J. O'M. Bockris and H. Wroblowa 83 p refs (See N64-33198 24-07)

APPENDIX II

8. ELECTROCHEMICAL KINETICS OF PARALLEL REACTIONS E. Gileadi and S. Srinivasan 15 p refs (See N64-33199 24-07)

N64-33198* Pennsylvania U., Philadelphia Electrochemistry Lab.

ELECTROCHEMICAL CATALYSIS

J. O'M. Bockris and H. Wroblowa *In its* Studies of the Fundamental Chem., Properties, and Behavior of Fuel Cells [1964] 83 p refs (See N64-33197 24-07) OTS: $4.00 fs; $1.00 mf

The factors affecting the rates of chemical and electrochemical reactions are discussed. The differences between chemical and electrochemical catalysis arising from the existence of an applied field and from the presence of solvent are discussed from the theoretical and experimental point of view. A discussion of the ways to enhance electrocatalysis is presented. The mechanisms of several electrode reactions (oxidation of hydrogen, hydrocarbons, oxalic acid, oxygen reduction) pertinent to fuel cell reactions are discussed, as a prerequisite to considerations of catalysis. An attempt is made to formulate some aspects of the mechanism of catalysis for the hydrogen-evolution and hydrocarbon-oxidation reactions. Author

N64-33199* Pennsylvania U., Philadelphia Electrochemistry Lab.

ELECTROCHEMICAL KINETICS OF PARALLEL REACTIONS

E. Gileadi and S. Srinivasan *In its* Studies of the Fundamental Chem., Properties, and Behavior of Fuel Cells [1964] 15 p refs (See N64-33197 24-07) OTS: $4.00 fs; $1.00 mf

The electrochemical oxidation of complex molecules (e.g. hydrocarbons) sometimes involves branched reactions. Under these conditions, it is difficult to define a reversible potential and the coulombic efficiencies of product formation may then be potential dependent. A number of cases of the kinetics of branched reactions of the type $A \rightarrow B \begin{matrix} \nearrow C \\ \searrow D \end{matrix}$, with step A→B rate-determining, are worked out. It is found that in most cases the coulombic yields are potential dependent over certain potential regions. The calculated variation of coulombic yields with potential is compared with results obtained in the anodic oxidation of some unsaturated hydrocarbons. Author

N64-33201* Rice U., Houston, Tex.

AN X-RAY DIFFRACTION STUDY OF NONPLANAR CARBANION STRUCTURES

Charles Bugg, Robert Desiderato, and Ronald L. Sass Repr. from J. Am. Chem. Soc., v. 86, 5 Aug. 1964 p 3157 refs (Grant NsG-6)

The crystal structures of the compounds ammonium tricyanomethide and pyridinium dicyanomethylide were determined by X-ray diffraction. Complete three-dimensional refinements indicate that significant deviation from planarity of the trigonal carbanion group exists for both compounds, even though the resonance stabilization of a planar configuration is possible. D.E.W.

N64-33237 California U., Livermore Lawrence Radiation Lab.

PREPARATION AND STUDY OF A SERIES OF BORANE AND TRIBOROHYDRIDE DERIVATIVES OF METHYLATED POLYAMINES

Franklin E. Walker 21 Jul. 1964 29 p refs
(Contract W-7405-ENG-48)
(UCRL-7973) OTS: $0.50

A series of borane and triborohydride derivatives of methylated polyamines have been prepared, and the variance in certain of their chemical and physical properties has been studied. The basic series consisted of polyamine chains of two, three, and four nitrogens separated by two carbon atoms and a chain of three nitrogens separated by three carbon atoms. The qualitative hydrolytic, thermal, and atmospheric stabilities were determined, and the densities and other physical properties were compared. Author

N64-33243 Pennsalt Chemicals Corp., King of Prussia, Pa. Technical Div.

RESEARCH ON NEW OXIDANTS AND MECHANISMS OF OXIDATION Semiannual Report, Dec. 1, 1963–Jun. 1, 1964

R. Helitzer et al Jun. 1964 33 p refs
(Contract DA-18-108-AMC-162(A))
(SAR-2; AD-444812)

The reaction of the following materials with perchloryl fluoride is discussed: dimethyl sulfide, piperidine, N-methylpiperidine, triethylamine, 0,0,0-triethyl thiophosphate, triethylenediamine, tri-n-butylphosphine, and 0,0-diethyl hydrogen dithiophosphate. Also studied were the following: (1) the reaction of t-butyl-2-chloroethyl sulfide with ClO_3F; (2) the reaction of 2,2,6,6-tetramethylpiperidine with ClO_3F in an attempt to prepare a stable N-perchlorylpiperidine; (3) the reaction of 2,2,6,6-tetramethylpiperidine-4-one with ClO_3F; (4) reaction of ClO_2SO_3F with piperidine; and (5) the ClO_2SO_3F reaction with dimethyl sulfide. The preparation of 2,2,6,6-tetramethylpiperidine-4-one; 2,2,6,6-tetramethylpiperidine; ClO_2; ClO_2F; and ClO_2SO_3F is given in appendixes. P.V.E.

N64-33303 Colorado U., Boulder

LITERATURE SURVEY OF ORTHOHYDROGEN AND PARAHYDROGEN RESEARCH

P. L. Barrick and L. F. Brown Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Aug. 1964 66 p refs
(Contract AF 33(616)-7654)
(APL-TDR-64-81; AD-605285)

A survey of the technical literature pertaining to orthohydrogen and parahydrogen is presented. The survey covers the literature from the prediction of the existence of the two forms of hydrogen in 1929 through October 1963. The abstracts are presented in five categories: ortho to parahydrogen conversion, para to orthohydrogen conversion, theories and mechanisms relating to ortho–para and para–orthohydrogen conversion, properties of ortho and parahydrogen, and reviews and miscellaneous. Author

N64-33336* Arizona U., Tucson Field Emission and Space Systems Lab.

DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES Second Semiannual Report, Jan. 1–Jun. 1. 1964

Stuart A. Hoenig and Melvin M. Eisenstadt [1964] 13 p refs
(Grant NsG-458)
(NASA-CR-59285) OTS: $1.00 fs; $0.50 mf

A chemisorption detector for hydrogen has been developed. This device operates over the pressure range from 10^{-5} to 10^{-8} torr and has a large and repeatable response to hydrogen. The detector makes use of the effect of hydrogen chemisorption on the work function of a palladium filament. This system is reasonably specific for hydrogen, and the effect of oxygen and nitrogen has been investigated. Oxygen has a substantial effect, but nitrogen does not. A similar detector for water vapor, using a barium-coated tungsten filament, has been tested and is undergoing further development. The large (18-in.-diam) uhv molecular beam system has been finished and leak checked. Author

N64-33370 Naval Radiological Defense Lab., San Francisco, Calif. Chemical Technology Div.

SOLUTE DISTRIBUTION IN THE Na_2O-B_2O_3-NaCl SYSTEM. III. IMMISCIBILITY DIAGRAMS OF MOLTEN SODIUM HALIDE-SODIUM POLYBORATES

B. L. Dunicz and R. C. Scheidt 22 May 1964 43 p refs
(Contract AT-(49-2)-1167)
(USNRDL-TR-752; AD-444154)

Immiscibility isotherms were obtained for the systems: boron oxide-sodium metaborate-sodium chloride at 810° C and 980° C, and boron oxide-sodium metaborate-sodium bromide and sodium iodide at 800° C and 980° C. Varied mixtures of the components were equilibrated at constant temperature in graphite crucibles sealed in silica glass tubes under vacuum. The immiscibility areas formed between the two conjugate liquid phases increase with the atomic number of the halide. For the same halide, however, those areas are only slightly affected by the changes in temperature. In the systems studied, the components appear to combine in definite stoichiometric relationships. Author

N64-33420 Midwest Research Inst., Kansas City, Mo.

SYNTHESIS OF ELASTOMERS CONTAINING Si-N BONDS IN THE MAIN CHAIN Quarterly Progress Report, 1 Jul.–30 Sep. 1964

L. W. Breed and R. L. Elliott 14 Oct. 1964 18 p refs
(Contract DA-23-072-ORD-1687)
(QPR-10; AD-607054)

A new polymer from bisphenol "A" and the cyclic $(Me_2SiOSiMe_2NMe)_2$ gave a tough, elastic polymer with an intrinsic viscosity of 2.22. The polymerization of aminosilanes with piperazines gave only low-molecular-weight polymers. The preparations of other silazane monomers and intermediates are described. Author

N64-33424 Naval Radiological Defense Lab., San Francisco, Calif.

ION EXCHANGE IN FUSED SALTS. I. A COMPARISON OF THE ION EXCHANGE CHARACTERISTICS OF FIVE MINERAL EXCHANGERS IN FUSED SODIUM NITRATE WITH REPRESENTATIVE ALKALI-METAL AND ALKALINE-EARTH CATIONS

C. M. Callahan and M. A. Kay 18 May 1964 32 p refs
(USNRDL-TR-754; AD-444361)

The ion-exchange characteristics of the zeolitic minerals chabazite, heulandite, analcite, and natrolite, and of the feldspathoid mineral sodalite, were surveyed in fused $NaNO_3$, using Na^{22}, Rb^{86}, Cs^{137}, and Ba^{133} as tracers. The survey was made to select a suitable solid ion exchanger that could be utilized effectively in a program concerned with ion exchange between fused salts and solid exchangers. The characteristics of interest that were investigated were the magnitude of the distribution coefficients, the reversibility of the exchange reaction, the time required to attain equilibrium in the exchange reaction, the thermal stability of the solid exchangers, and the compatibility of the solid exchanger with the fused media. Author

N64-33434 Atomics International, Canoga Park, Calif.
CONFORMAL IONIC MIXTURES
Milton Blander and S. J. Yosim 15 Oct. 1964 28 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8880) OTS: $0.50

The excess free energy of mixing of molten reciprocal salt solutions (A^+, B^+, X^-, Y^-) has been calculated up to the second order by the perturbation method of Reiss, Katz, and Kleppa. The result is a power series containing integral powers of the ion fractions (concentrations). This demonstrates that mixtures of two salts of the same valence type cannot be considered as a mixture of a salt with a dielectric solvent. The first term in the series is proportional to the free energy change for the reaction $AX + BY \rightarrow AY + BX$ and is the same as the theory of Flood, Førland, and Grjotheim. The results of the symmetric approximation based upon the quasi-lattice model are consistent with the first term and one of the second-order terms. The remaining second-order terms are related to the excess free energy of mixing in the binary systems AX–AY, BX–BY, AX–BX, AY–BY and are of a form first suggested by Førland.
Author

N64-33467 Los Alamos Scientific Lab., N. Mex.
DETERMINATION OF YTTRIUM IN TANTALUM-YTTRIUM ALLOYS
K. S. Bergstresser and G. R. Waterbury 6 Oct. 1964 12 p refs
(Contract W-7405-ENG-36)
(LA-3123) OTS: $0.50

A method is described for the determination of yttrium in tantalum–yttrium alloys that contain from 0.025% to 0.25% yttrium. In the analysis, hydrofluoric acid is added to alloy samples to dissolve tantalum and to convert yttrium to an insoluble fluoride. This yttrium fluoride is separated from all tantalum by centrifuging and then heated to fumes with perchloric acid to remove interfering fluoride ions and to obtain yttrium in solution form. Addition of arsenazo I to the borate-buffered yttrium solution produces a soluble, colored yttrium complex that is used for spectrophotometric determination of yttrium. The standard deviation was estimated to be 2μg of yttrium from data obtained in analyzing fifteen samples, each containing 100 mg of tantalum and from 25μg to 125μg of yttrium.
Author

N64-33468 Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM QUANTITIES OF COBALT IN TANTALUM AND PLUTONIUM
T. K. Marshall, J. W. Dahlby, and G. R. Waterbury 7 Oct. 1964 18 p refs
(Contract W-7405-ENG-36)
(LA-3124) OTS: $0.50

A sensitive spectrophotometric method was adapted for the determination of trace amounts of cobalt in tantalum and plutonium. The cobalt (2μg to 42μg) is complexed with 2-nitroso-1-naphthol and extracted into chloroform from an aqueous sodium citrate solution at pH 4. The extract is washed to remove excess color reagent, and the absorbance is measured at 530 mμ. The molar absorptivity of the color complex is 14300. The relative standard deviation is no greater than 1.5% for a single determination of cobalt in the concentration range between 10.0 and 83 ppm in 500 mg of tantalum or plutonium. A positive bias of 4% was found at the 4-ppm level, but no bias existed for concentrations greater than 10 ppm. Of 37 ions tested, only the ions containing iodine, platinum, or ruthenium caused serious interference, and iodine may be removed by evaporation of the solution to near dryness with perchloric acid.
Author

N64-33494 Dow Chemical Co., Midland, Mich. Scientific Projects Lab.
OBSERVATION AND KINETIC INVESTIGATION OF THE NF AND NF_2 RADICALS
R. W. Diesen 27 Jul. 1964 7 p refs
(Contract Nonr-3814(00))
(AR-1S-64; AD-603653)

The high-temperature decomposition of the NF_2 radical was investigated in a shock tube coupled to a time-of-flight mass spectrometer. The reactive NF diradical has been observed, and initial kinetic results are discussed. The NF_2, NF, F, and N_2 were the only species observed in a dilution of 0.25% to 1% in an inert gas. From the mathematically determined steady-state approximations and from the experimental maximum NF concentration, a simple reaction mechanism for the decomposition of the NF_2 radical was found. At temperatures below 1900° K, the observation of NF_3 as an additional product was made.
G.G.

N64-33672 Colorado U., Boulder
HALOGENOID COMPLEXES Progress Report, 1 Oct. 1963-31 Mar. 1964
R. N. Keller [1964] 7 p refs
(Grant DA-ARO(D)-31-124-6198)
(PR-5; AD-447819)

This is a report on the chemistry of azide (N_3^-), cyanate (OCN^-), and other pseudo halic acids. The thermodynamic equilibrium constants of several azides in an aqua solution were obtained spectrophotometrically and compared favorably with those obtained by electrometrical determination. Preliminary tests of cyanate compounds revealed the influence of the cation size on the nature of the colored product.
G.G.

N64-33677 Weizmann Inst. of Science, Rehovoth (Israel) Polymer Dept.
MECHANOCHEMISTRY OF COUPLED CONTRACTILE AND CHEMICAL RATE PROCESSES Final Report
A. Katchalsky Jan. 1964 189 p refs
(Grant AF-EOAR-62-58)
(AD-600541) OTS: $5.00

This report pertains to the efficient conversion of chemical energy into mechanical energy by macromolecular systems in living units such as muscles, flagella, or contractile membranes. The detailed behavior of crosslinked and swollen rubbers was studied, and the energetic parameters of interaction between the contractile gel and the added reagent were evaluated, with emphasis on the equilibrium and rate studies on collagen fibers. An elasto-osmotic method for the determination of the colligative properties and molecular weights of a polymer solution was developed by equations. The contraction rates in solutions of different strength in isotonic and isometric conditions were determined by diffusion equations. The general kinetics of the contraction rates were found by an equation of the contraction rate as the function of force. Several contractile fiber models were constructed and found to be working satisfactorily in cyclic processes.
G.G.

N64-33679* Aerojet-General Corp., Azusa, Calif.
RESEARCH ON PROCESSES FOR UTILIZATION OF LUNAR RESOURCES Summary Report No. 2895, 16 Nov. 1963-15 Jul. 1964
S. D. Rosenberg, G. A. Guter, and F. E. Miller Aug. 1964 72 p refs
(Contract NAS7-225)
(NASA-CR-59167) OTS: $3.00 fs; $0.75 mf

Laboratory apparatus for studying the reduction of igneous rock with carbon, hydrogen, and methane was designed, fabricated, and operated. Several experiments demonstrated that

with the use of specially designed inlet tubes, methane reacts with silicate materials at 1600° C to form carbon monoxide, hydrogen, silicon, carbon, and slag. Quantitative recovery of carbon was achieved. Reactor materials were found that allow the reaction to run at 1600° C for long time periods. Author

N64-33708 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
HIGH INTENSITY PHOTOLYSIS OF AZO COMPOUNDS AT 3600 Å
Jack Oliver Terry (M.S. Thesis) May 1964 73 p refs
(GNE/Phys/64-18; AD-603679) OTS: $3.00

The objective of the work was to develop a technique for studying the relative rates of disproportionation and combination of unlike radicals and the first system studied was ethyl–propyl. To obtain this value it was necessary to reinvestigate the rates of disproportionation and combination of ethyl and propyl radicals under high intensity conditions. The ratios were constant with pressure for azo ethane and azo propane photolysis. These ratios are 0.138 ±0.009 for ethyl and 0.142 ±0.015 for propyl radicals. The cross disproportionation to combination ratios were 0.045 ±0.012 for ethylene + propane and 0.049 ±0.016 for ethane + propylene. In addition to the ratios of rate constants, the quantum yields of decomposition were studied as a function of pressure of the azo compounds. Author

N64-33713 Pennsylvania U., Philadelphia Electrochemistry Lab.
HYDROGEN EMBRITTLEMENT RESULTING FROM CORROSION, CATHODIC PROTECTION, AND ELECTROPLATING Third Quarterly Report
L. Nanis and J. Mc Breen 1 Aug. 1964 15 p refs
(Contract N-156-44134)
(AD-446525)

The permeation rate of hydrogen through iron membranes was studied as a function of potential in various electrolytes. Graphs of permeation rate are presented for different solutions and as a function of potential, of solute concentration, of the square root of cathodic current, and of temperature. D.E.W.

N64-33815 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
RADIOLYSIS OF PROPANE AT LOW CONVERSION
Norman Keith Blocker (M.S. Thesis) Aug. 1964 50 p refs
(GNE/Phys/64-2; AD-603605)

The calculated G-value for ethane in the low conversion region was 1.95. All other product yields were determined relative to this value. Significant increases in yields for propylene and ethylene were observed as the degree of conversion was decreased from 2.6% to 0.0045%. These increases were attributed to the absence of internal scavenging reactions involving hydrogen atom attack on these products. A decrease in the yield of 2,3 dimethylbutane was accompanied by an increase in the yields of methane and ethane, as the conversion was increased from 0.05% to 1.00%. It was concluded that the initial yields for the radiolysis products were represented by the product yields at the lowest degree of conversion. Author

N64-33817 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
AN INFRARED STUDY OF THE EFFECT OF SOLVENT ON THE Si-H STRETCHING VIBRATION
William A. Swansiger (M.S. Thesis) May 1964 135 p refs
(GNE/Phys/64-17; AD-603678)

Forty-four different solvents, ranging from 1.8 to 40 in dielectric constant, and five silanes are studied. The silanes are triethyl silane, tricyclohexyl silane, diphenyl methyl silane, triphenyl silane, and tribenzyl silane. Triphenyl silane and diphenyl methyl silane are studied extensively in the paraffins (pentane to hexadecane plus paraffin oil). Some of the better-known relationships involving dielectric constant are tested, but none of them fit the data over the entire range of solvents studied. The Kirkwood–Bauer–Magat relationship ($\Delta\nu/\nu_0 = C(D-1)/2D+1$) where $\Delta\nu/\nu_0$ is the relative frequency shift, C is a constant, and D is the solvent dielectric constant, gives the best fit for nonpolar solvents. No relationship considering only nonspecific effects, i.e., refractive index, dielectric constant, viscosity, etc., is found to be valid over the entire range of solvents studied. Author

N64-33820 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
RE-EXAMINATION OF THE LUMINESCENT PROPERTIES OF THE MIXED PHENYL- AND P-BIPHENYL SILANES
Edward A. Peterson (M.S. Thesis) May 1964 132 p refs
(GSP/Phys/64-11; AD-603615)

Some luminescent properties of the tetraaryl silane family composed of tetraphenyl silane, triphenyl-p-biphenylyl silane (Silane I), diphenyl-di-p-biphenylyl silane (Silane II), phenyl-tri-p-biphenylyl silane (Silane III), and tetra-p-biphenylyl silane (Silane IV) were reexamined to determine the effect of a p-quaterphenyl impurity on the luminescent properties previously reported. The luminescent properties investigated include molar extinction coefficient determinations, fluorescence of glass silanes, fluorescence in cyclohexane solutions at 293° K, fluorescence in EPA at 293° K and 77° K, and phosphorescence in EPA at 77° K. Also, mean lifetimes of phosphorescent bands were determined. Author

N64-33843 Illinois U., Urbana
ELECTRON COUPLING OF NUCLEAR SPINS. VIII: TEMPERATURE DEPENDENCE OF J_{FF} IN 2-FLUOROBENZOTRIFLUORIDES
J. Jonas and H. S. Gutowsky 27 Jul. 1964 31 p refs Submitted for Publication
(Contract Nonr-1834(13))
(TR-73; AD-603636)

The F-F coupling constant between the CF_3 group and the fluorine atom at the 2-position was measured and found to have an appreciable temperature dependence in several 2-F, 6-X-benzotrifluorides. The magnitude of $J_o^{FF}(F\text{-}CF_3)$ and the direction of its change with temperature is consistent with the existence of two different rotational conformations of the CF_3 group, whose relative stability depends upon the balance of repulsive steric interactions between the CF_3 group and the 2- and 6-substituents. These results were supported and extended by measurements of the fluorine chemical shifts for the CF_3 and 2-F, both of which move downfield with increasing temperature. For a particular compound, the ΔE between the two conformations is the potential barrier to internal rotation of the CF_3 group, and the temperature dependences of $J_o^{FF}(F\text{-}CF_3)$ and of the fluorine chemical shifts are attributed to thermally excited torsional oscillations and reorientations of the CF_3 group in the potential well. Author

N64-33851 California U., Livermore Lawrence Radiation Lab.
PREPARATION AND CHARACTERIZATION OF HIGH-PURITY THORIUM DICARBIDE
N. D. Stout 16 Sep. 1964 11 p refs
(Contract W-7405-ENG-48)
(UCRL-12003) OTS: $1.00

Thorium carbide (ThC_2) was prepared by arc melting, characterized by metallographic and X-ray techniques, and tested for its low-temperature heat capacity. Care was taken to prepare the highest-purity material possible in order to make impurity effects measurable by comparison with other samples. The composition, X-ray diffraction patterns, and metallographic information are tabulated. D.E.W.

N64-33879 Los Alamos Scientific Lab., N. Mex.
X-RAY ABSORPTION EDGE DETERMINATION OF RHENIUM IN RHENIUM–URANIUM–ZIRCONIUM CARBIDE
E. A. Hakkila, R. G. Hurley, and G. R. Waterbury 13 Oct. 1964 16 p refs
(Contract W-7405-ENG-36)
(LA-3135) OTS: $0.50

Rhenium is determined in rhenium–uranium–zirconium carbide using an X-ray absorption edge method. In this method a bismuth–thallium alloy is irradiated with X-rays from a tungsten-target X-ray tube, and the secondary X-rays of bismuth and thallium are transmitted through an absorption cell filled successively with water, suitable known solutions, and the sample solution. The L III absorption edge for rhenium at 1.177 Å occurs between the $L\alpha_1$ lines for thallium at 1.207 Å and for bismuth at 1.144 Å. Measured transmitted intensities are related to rhenium concentration using accepted absorption principles. The method is applicable to the determination of rhenium concentrations of 20% to 100% with relative standard deviations in the range of 2.8% to 0.6%, respectively. Only gallium, ytterbium, lutetium, and hafnium have absorption edges between the X-ray lines used for this analysis and interfere in this method. Author

N64-33887 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
SYNTHESIS OF CYCLOALKANONE ALKYLHYDRAZONES AND FACTORS INFLUENCING ISOMERIZATION TO CYCLOALKANE AZO ALKANES
John Joseph Scheloske (M.S. Thesis) May 1964 85 p refs
(GNE/Phys/64-15; AD-603684)

A chemical equilibrium exists between cycloalkanone alkylhydrazones and cycloalkane azo alkanes. Cyclic compounds that had various internal bond angles were used. The results of this study show that the effect of bond-angle strain is a factor in the percentage of hydrazone contained in the equilibrated samples of originally pure azoalkanes. The cycloalkanone alkylhydrazones were synthesized by the condensation reaction of cyclopentanone, cyclohexanone, cycloheptanone, and cyclooctanone with methylhydrazine. The hydrazones were refluxed over KOH to isomerize to the corresponding cycloalkane azo alkanes. The physical properties reported include boiling point, refractive index, infrared absorption spectra, and ultraviolet absorption spectra. The equilibrium composition was determined with the use of ultraviolet spectroanalyses. Author

N64-33892 Chalmers U. of Tech., Göteborg (Sweden)
SURFACE CHEMISTRY AND CORROSION
J. Arvid Hedvall Scand. U. Books, 1963 22 p refs *Its* Trans. No. 271 Available from Scand. U. Books: 6 SK

The practical importance and application of various surface reactions and the associated corrosion are treated. Diagrams, metallographic microphotographs, reaction kinetics curves, and yield curves support the nontechnical discussion. D.E.W.

N64-33912 Dow Chemical Co., Midland, Mich.
ANALYTICAL METHODS FOR IMPURITIES IN CESIUM METAL Final Report, 1 Jul. 1963–25 May 1964
V. A. Stenger, O. U. Anders, C. E. Van Hall, R. J. Moolenaar, W. R. Kramer et al Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1964 103 p refs
(Contract AF 33(657)-11209)
(ML-TDR-64-199; AD-607272)

Methods have been developed and tested for the determination of oxygen, nitrogen, and carbon in cesium metal, in concentrations of from less than 10 to more than 300 ppm. In general the methods appear to be free from interferences. Oxygen is the only impurity likely to be found in more than extremely small traces in high-quality cesium metal. The determination of oxygen can be carried out by the nondestructive neutron activation method, newly developed to give sufficient sensitivity, or by a new modification of the butyl bromide method designed to improve the accuracy. The methods developed for nitrogen and carbon permit identification of the forms in which these elements are most likely to occur, even though their concentrations are in the order of only 5 ppm. Author

N64-33913 National Co., Inc., Malden, Mass.
CESIUM ANALYSIS STUDY Technical Documentary Report, Jul. 1963–Apr. 1964
Thomas Athanis Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1964 43 p
(Contract AF 33(657)-11749)
(ML-TDR-64-200; AD-607218)

Mass-spectrometric analysis showed that the predominant gaseous impurities evolved from cesium samples subjected to high-temperature reflux distillation in high vacuum were H_2, N_2, and CO. Results obtained from 15-g cesium samples are summarized according to total number of gas molecules, major gaseous impurities (%), minor gaseous impurities (%), and total gaseous impurity content (ppm). Author

N64-33920* General Electric Co., Philadelphia, Pa. Missile and Space Div.
STUDY OF THE GROWTH PARAMETERS INVOLVED IN SYNTHESIZING BORON CARBIDE FILAMENTS First Quarterly Report
A. Gatti, R. Cree, R. Mehan, and C. Mancuso Sep. 1964 23 p refs
(Contract NASw-937)
(NASA-CR-59381) OTS: $1.00 fs; $0.50 mf

In addition to the routine runs that provided a supply of B_4C whiskers for further studies, vanadium was found, after a lengthy search, to be the best catalyst for markedly increasing both the quantity and the size of B_4C whiskers grown. Surface morphology of B_4C whiskers was studied, and tensile tests of the whiskers at room temperature yielded results varying between 179 ksi and 965 ksi. Composites of B_4C-epoxy and B_4C-aluminum were fabricated and tension tested at room temperatures, giving strengths of 29.5 ksi and 29.0 ksi, respectively. D.E.W.

N64-33926 Ethyl Corp., Baton Rouge, La.
RESEARCH ON LIGHT METAL FUELS AND OXIDIZER CHEMISTRY. PART II: OXIDIZER CHEMISTRY Quarterly Progress Report No. 4, May–Jul. 1964
W. E. Becker and D. H. Campbell [1964] 9 p refs
(Contract AF 04(611)-9376; ARPA Order 24)
(EC-670; AD-607168)

The cryoscopic behavior of HNF_2 in concentrated sulfuric acid solutions has been measured. The average of the values for the molecular weight of HNF_2 was 52.7 compared to the calculated formula weight of 53. These data indicate that little

or no ionization of HNF_2 occurs in H_2SO_4 at room temperature. A kinetic investigation of the reaction of HNF_2 with deuterium oxide is in progress. The results indicate that HNF_2 ionizes slightly in tetrahydrofuran (THF) solutions. The ionization constant is lower than that of water. A similar investigation of the isotopic exchange of $ClNF_2$ with HCl has been initiated. An investigation of the conductivity of $ClNF_2$ in nitrobenzene solution is in progress. Author

N64-33973 Martin Co., Baltimore, Md. RIAS
THEORETICAL AND QUANTUM CHEMISTRY OF N, O, F COMPOUNDS Quarterly Technical Report No. 2, 9 Jul.–9 Oct. 1964
Joyce J. Kaufman [1964] 28 p refs
(Contract DA-31-124-ARO-D-203; ARPA Order 542)
(AD-450087)

Eigenvalues and eigenvectors were obtained for NF_2, NF_3, and the cis and trans forms of both N_2F_2. For the isomers of N_2F_2 and for NF_3, population analyses were performed giving the total gross atomic populations and the total overlap populations of every pair of atoms in the molecule. Calculations were performed with the POLYATOM program (rigorous LACO-MO-SCF computations using gaussian basis orbitals) to check the optimization of the parameters for the N and F atoms. Work on the POLYATOM program and some supplements to it are reported. D.E.W.

N64-33981 Imperial Coll. of Science and Tech., London (Gt. Brit.)
ADSORPTION AND SORPTION COMPLEXES Final Technical Report, 1 Jul. 1961–30 Jun. 1964
[1964] 39 p refs
(Contract DA-91-591-EUC-2980)
(AD-447257)

A comparative study of the sorption of the elements sulfur, phosphorus, and mercury by a number of zeolites was made. The sorption of sulfur and phosphorus by the zeolites with the more open structures gives isotherms that are remarkably rectangular, in view of the high temperature of the sorbents. The uptake of mercury by the sodium and lead forms of sieve X is smaller than would be expected from the magnitude of the interatomic forces in liquid mercury. A comparative study of the mercury sorption of the silver forms of a number of zeolites was also carried out. D.E.W.

N64-33983 Monsanto Research Corp., Everett, Mass. Boston Lab.
RESEARCH TO IMPROVE ELECTROCHEMICAL CATALYSTS Final Technical Report, 15 May 1963–15 May 1964
J. O. Smith, R. M. Kliss, E. A. Mc Elhill, S. Matsuda, J. McDonald et al 27 Jul. 1964 74 p refs
(Contract DA-44-009-AMC-202(T); ARPA Order 437)
(AD-434194L)

Of the 35 chelates prepared, purified, and tested, 33 were active for the oxidation of hydrazine, 19 were active for formic acid, and 12 were active for acetic acid. In tests on insoluble fuels, several chelates were found active for the oxidation of hydrogen, and at least one showed activity for propane. Work on soluble fuels was complicated by the fact that the observed activity of the catalyst was highly dependent on method of preparing the chelate electrode. Several electrode systems have been tested. The chelates were also tested for their ability to catalyze the oxidation of hydrogen on a palladium foil membrane. Several chelates were found active in this test; however, the results obtained were dependent on the method by which the chelate was applied to the membrane. Author

N64-33995 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 118
26 Oct. 1964 61 p refs Transl. into ENGLISH from Chinese publ.
(JPRS-27079; TT-64-51335) OTS: $3.00

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2. CHEMICAL STRUCTURE OF SEVERAL HETEROCYCLIC COMPOUNDS OF IODINE AND THEIR PRESSURE-LOWERING EFFECTS Liang Chung-Tung, Wang Chi-Kuang, and Chang P'ei-Yen 5 p refs
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12. SECOND NATIONAL CEMENT CONFERENCE Li Li-Li 4 p
13. ACADEMIC CONFERENCES 1 p
14. AGRICULTURAL METEOROLOGICAL CONFERENCE 1 p
15. OPEN-CUT MINING CONFERENCE 2 p
16. CORROSION AND PROTECTION CONFERENCE 1 p
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18. SIXTH NATIONAL PEDIATRIC CONFERENCE 2 p
19. BOOK REVIEW Chu Hsiang-Ch'ing 2 p

N64-33997 Joint Publications Research Service, Washington, D.C.
ADSORPTION OF OXYGEN ON NIO-Li_2O CATALYTIC AGENTS
Wang Hung-Lieh, Huang Kwei-Ch'ang, and Lou P'ei-P'ei *In its* Transl. on Communist China's Sci. and Technol. 26 Oct. 1964 7 p refs (See N64-33995 24-07) OTS: $3.00

An investigation to determine whether adsorbed oxygen on NiO-Li_2O catalysis exists in different forms is dicussed. The investigation was carried out by observing the energy loss of the catalyst as well as the variation of resistance during the process of adsorption. Five samples of the NiO-Li_2O catalytic agents having the following amounts of additive Li_2O were used: 0, 0.08, 0.8, 4, and 8 at.%. It was also found that the amount of adsorbed oxygen increases with time, whereas the speed of adsorption decreases with time, with equilibrium being reached in about 200 minutes. The equilibrium adsorption amount decreased as the amount of additive Li was increased. The adsorption of oxygen was also found to increase

the energy escaping from the catalysts. From the results obtained, it is concluded that the adsorbed oxygen exists in two states—one negatively charged and the other neutral. P.V.E.

N64-33998 Joint Publications Research Service, Washington, D.C.
SPECTROPHOTOMETRY OF TITANIUM
Li Chieh-chun and Ch'en Shun-ming *In its* Transl. on Communist China's Sci. and Technol. 26 Oct. 1964 2 p refs (See N64-33995 24-07) OTS: $3.00

The effect of 4(2-azopyridine) resorcinol (PAR) and PAR hydrogen peroxide on Ti was studied, and the possibility that the chromatic complex products could be used in the spectrophotometry of Ti was investigated. The maximum absorption peak of the red complex produced from the reaction between Ti and PAR was located at 520 mμ. By using Job's slope ratio, the composition of the complex was found to be TI:PAR = 1:2. In the spectrometric readings, there was no interference from oxalic acid, d-tartaric acid, and citric acid; some interference from phosphate radicals Nb, Ta, Zr, Hf, Th, and W; and serious interference from Cu, Zn, Co, Ni, and Fe. In the presence of H_2O_2, the reaction between PAR and Ti yielded a red–orange-colored complex with a maximum absorption peak at 510 mμ. The complex was found to have a composition of Ti:H_2O_2:PAR = 1:1:1. There was no spectral interference from a large amount of chlorine ions; nitrate radicals; sulfate radicals; Na, K, and Mg; oxalic acid; citric acid; and d-tartaric acid, but there was serious interference from Cu, Zn, Co, and Fe. P.V.E.

N64-34001 Case Inst. of Tech., Cleveland, Ohio
SOME GERMANIUM MACROCYCLIC COMPLEXES
John N. Esposito, Laurel E. Sutton, and Malcolm E. Kenney 6 Aug. 1964 14 p Submitted for Publication
(Contract Nonr-1141(18))
(TR-1; AD-604117)

The macrocyclic germanium complexes, $hpGeF_2$, $hpGeCl_2$, $hpGeBr_2$, $hpGe(OH)_2$, $(hpGeO)_x$, $hpGe(OC_4H_9 - n)_2$, $hpGe(OC_6H_5)_2$, $PcGeF_2$, $PcGeBr_2$, and $PcGeI_2$ are reported together with additional data on hpH_2, $PcGeCl_2$, and $(PcGeO)_x$. A comparison is made of the low-frequency infrared spectra of the oxy, hydroxy, and halo complexes. Evidence is given that indicates that $(hpGeO)_x$ is similar in structure to $(PcGeO)_x$.
Author

N64-34006 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 116
21 Oct. 1964 76 p refs Transl. into ENGLISH from Chinese periodicals
(JPRS-27009; TT-64-51265) OTS: $3.00

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2. THE EFFECT OF LOBE HORMONES ON FISH OVARY PROTEIN AND NUCLEIC ACID METABOLISM Chang Shih-Jung, Liu Chan-Huan, and Chang Chih-i p 13–24 refs

3. CHEMICAL COMPOSITION OF IRON METEORITES Hou Ying, Li Chao-Hui, and Lin Hsiang-K'eng p 25-34 refs (See N64-34008 24-07)

4. SCIENTIFIC CONFERENCE ON WATER PURIFICATION Chu Shih-Ming p 35-44

5. SIXTH PEDIATRIC CONFERENCE OF THE CHINESE MEDICAL ASSOCIATION T'ung Erh-Ch'ang p 45-49

6. SCIENTIFIC CONFERENCE ON AGRICULTURAL METEOROLOGY Hsu Chi-Ch'ang p 50-55 (See N64-34009 24-22)

7. SCIENTIFIC CONFERENCE ON THE SELECTIVE BREEDING OF TREES Hsu Wei-Ying p 56–58

8. CONGRATULATING THE FIRST GROUP GRADUATING FROM THE MATHEMATICS DEPARTMENT, PEKING TELEVISION UNIVERSITY Tuan Hsueh-Fu p 59–60

9. GREAT ACHIEVEMENTS OF OUR AGRICULTURAL SCIENCES DURING THE PAST 15 YEARS Chin Shan-Pao p 61–67

10. SZECHWAN PROVINCIAL INSTITUTE OF AGRICULTURAL SCIENCE AIDS EFFORT TO CONTROL COTTON-KILLING DISEASE p 68–73

N64-34007 Joint Publications Research Service, Washington, D.C.
DETERMINATION OF SUCCESSIVE FORMATION CONSTANTS AND MOLECULAR ABSORPTION SPECTRA BY SPECTROPHOTOMETRY
Chang Cheng-pin *In its* Transl. on Communist China's Sci. and Technol., No. 116 21 Oct. 1964 p 1–12 refs (See N64-34006 24-07) OTS: $3.00

The use of spectrophotometric data for determining successive formation constants of mixed complexes has been suggested. Based upon previous discussion concerning mononuclear and polynuclear complexes, a new theory of, and a method for determining the constants are presented. The method is applicable to cases where more than four complexes exist simultaneously in a system. Besides being used to handle polynuclear complexes, the method may also be used in experiments involving polar spectrums, electric conductance, and refractive index. P.V.E.

N64-34008 Joint Publications Research Service, Washington, D.C.
CHEMICAL COMPOSITION OF IRON METEORITES
Hou Ying, Li Chao-hui, and Lin Hsiang-K'eng *In its* Transl. on Communist China's Sci. and Technol., No. 116 21 Oct. 1964 p 25–34 refs (See N64-34006 24-07) OTS: $3.00

A study was made of the chemical composition of the meteorites found in Shang-tu, Hopei; Nan-tan, Kuangsi; Sinkiang; Feng-chen, Inner Mongolia; Tai-hai, Liang-ch'eng, Inner Mongolia; and Wu-chu-mu-hsin, Inner Mongolia. Their specific gravity and their acmitic width were also measured. The chemical composition of these meteorites was found to be the same as that usually found in meteorites. It was found that the nickel content varied strictly with the acmitic width—the narrower the acmitic width, the higher the nickel content. Also studied was the distribution, by valences, of iron, in the iron meteorite in Shang-tu. The results showed that the most of the iron exists in the 0 valence state. The two-valence iron was unevenly distributed; this is related to the fact that sulfuric iron is also unevenly distributed. The ratio of Fe^{+3} to Fe^{0} was found to be close to 0. P.V.E.

N64-34011* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
A STUDY OF IRRADIATION-INDUCED ACTIVE SITES ON MAGNESIUM OXIDE USING ELECTRON PARAMAGNETIC RESONANCE
Jack H. Lunsford Repr. from J. Phys. Chem., v. 68, no. 8, Aug. 1964 p 2312–2316 refs
(NASA-RP-348)

This investigation is a study of the ultraviolet irradiation-induced catalytic activity of MgO and the electron paramagnetic resonance spectra on the same sample. The data show that a correlation exists between the V_1 center concentration and the enhanced catalytic activity for the hydrogen–deuterium exchange reaction, $H_2 + D_2 \rightleftharpoons 2HD$. Samples were subjected to degassing at 290° and 500°; thermal decay at −79°, 0°, and 30°; and 2537-Å ultraviolet as a function of time; and several wavelengths of ultraviolet light. It is concluded that either a V_1-type center existing on the surface is an active site for the exchange reaction, or the V_1 center formation is an integral step in the formation of the active site; that is, it is a hole trap that prevents recombination. Author

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-32756 North American Aviation, Inc., Los Angeles, Calif. Space and Information Systems Div.
EXPERIMENTAL LASER SPACE COMMUNICATIONS PROGRAM. TASK I: PROBLEM DEFINITION, VOLUME II
9 Oct. 1964 320 p refs
(SID-64-1894-2)

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2. THE RELATIONSHIP BETWEEN RANDOM OPTICAL WAVE FRONT DISTORTION AND OPTICAL SYSTEM PERFORMANCE D. L. Fried p 74–134 (See N64-32758 24-08)

3. OPTICAL HETERODYNE DETECTION OF AN ATMOSPHERICALLY DISTORTED SIGNAL WAVE FRONT D. L. Fried p 135–170 refs (See N64-32759 24-08)

4. THE STATISTICS OF GEOMETRICAL INTERPRETATION OF WAVE FRONT DEFORMATION D. L. Fried and J. D. Cloud p 171–184 refs (See N64-32760 24-08)

5. THE SIGNIFICANCE OF THE INNER SCALE OF TURBULENCE TO THE PHASE STRUCTURE FUNCTION J. D. Cloud and D. L. Fried p 185–194 (See N64-32761 24-08)

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7. FURTHER EVALUATION OF PHASE AND AMPLITUDE CORRELATION FUNCTIONS FOR AN ATMOSPHERICALLY DISTORTED WAVE FRONT J. D. Cloud p 225–266 refs (See N64-32763 24-08)

8. THE ANGULAR SCINTILLATION CORRELATION FUNCTION D. L. Fried p 267–287 ref (See N64-32764 24-08)

9. RMS ANGULAR RESOLUTION BY THE WAVE FRONT APPROXIMATION TECHNIQUE D. L. Fried p 288–294 refs (See N64-32765 24-08)

10. ATMOSPHERIC OPTICAL DOPPLER: AN APPROXIMATE EVALUATION D. L. Fried p 295–306 refs (See N64-32766 24-08)

N64-32757 North American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
ATMOSPHERIC TURBULENCE AND ITS EFFECT ON LASER COMMUNICATION SYSTEMS. SECOND REPORT
D. L. Fried and J. D. Cloud *In its* Exptl. Laser Space Commun. Program Task I: Probl. Definitions, Vol. II 9 Oct. 1964 p 1–73 refs (See N64-32756 24-08)
(TM-91)

A generalization is given of Rytov's method for obtaining an approximate solution of the wave equation for a plane wave propagating through an inhomogeneous medium. This generalization is valid for any wave forms (such as spherical, elliptical, etc.), and from it Rytov's original result for plane waves can be derived as a special case. D.E.W.

N64-32758 North American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
THE RELATIONSHIP BETWEEN RANDOM OPTICAL WAVE FRONT DISTORTION AND OPTICAL SYSTEM PERFORMANCE
D. L. Fried *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 74–134 (See N64-32756 24-08)
(TM-89)

The performance parameters concern angular and amplitude scintillation and efficiency of a coherent detection system. The results, for arbitrary diameter optics, are expressed in terms of one-dimensional integrals involving the correlation functions phase and log amplitude. The correlation function for the angular tilt of the wave front is used initially, but it is subsequently shown that the same results can be obtained with the use of only the phase correlation function. To achieve this, the concept of a best fit polynomial approximation to the perturbed wave front is introduced, and the mean square value of the polynomial's coefficients is obtained. These values are related to the angular scintillation problem. Author

N64-32759 North American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
OPTICAL HETERODYNE DETECTION OF AN ATMOSPHERICALLY DISTORTED SIGNAL WAVE FRONT
David L. Fried *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 135–170 refs (See N64-32756 24-08)
(TM-118)

The effect of atmospheric distortion of an optical wave front on the performance of an optical heterodyne detection system is examined theoretically. With the distortion measured by the phase structure function, an exact expression is derived relating the distortion to the detector signal-to-noise ratio. Because of distortion there is a limit to the achievable signal-to-noise ratio no matter how large the detector collection aperture is. The minimum aperture diameter that will (nearly) achieve this limit, called the efficiency saturation dimension, r_0, is obtained in terms of the phase structure function. Using the current theory for propagation in a turbulent medium, an expression for r_0 is obtained for a receiver in the atmosphere looking at a source above the atmosphere. The expression is in terms of the wavelength, the receiver altitude, and the zenith angle of the receiver line of sight. Author

N64-32760 North American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
THE STATISTICS OF GEOMETRIC INTERPRETATION OF WAVE FRONT DEFORMATION
D. L. Fried and J. D. Cloud *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 171–184 refs (See N64-32756 24-08)
(M-119)

The geometric interpretation of wave front deformation is studied using the phase structure function and the method of wave front approximation. The shape of the deformation is analyzed in terms of planes (tilted and translated), spherical surfaces, and hyperboloid (saddle) surfaces. The area over which the deformed wave can be considered to contain only certain types of deformation is derived. Author

N64-32761 North American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
THE SIGNIFICANCE OF THE INNER SCALE OF TURBULENCE TO THE PHASE STRUCTURE FUNCTION
J. D. Cloud and D. L. Fried *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 185–194 (See N64-32756 24-08)
(TM-120)

The relative inaccuracy involved in using the equation

$$D_{\phi\phi}(l) = k^2 D A L_0^{-2/3} (2.91 l^{5/3})$$

to represent the phase structure function everywhere is determined. Results of computations are plotted in a graph, and it is concluded that using the above equation to represent the phase structure function is always justified, and that the phase structure function is adequately derived without consideration of the inner scale of turbulence. D.E.W.

N64-32762 North American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
EXTENSION OF RESULTS FOR PHASE AND LOG AMPLITUDE CORRELATION: HIGHER-ORDER TERMS IN THE NEAR-FIELD SERIES AND COVERAGE OF THE FAR-FIELD
D. L. Fried and M. F. Sternberg *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 195–224 (See N64-32756 24-08)
(TM-125)

The validity of the power series expansion used in the η and ζ integrations is considered, and the infinite series results for the η and ζ integrations are given. The convergence of the correlation function series for the near-field approximation is discussed. New results were obtained for propagation paths mostly in the far field. D.E.W.

N64-32763 North American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
FURTHER EVALUATION OF PHASE AND AMPLITUDE CORRELATION FUNCTIONS FOR AN ATMOSPHERICALLY DISTORTED WAVE FRONT
J. D. Cloud *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 225–266 refs (See N64-32756 24-08)
(TM-127)

Subjects discussed include the variation of l_0 with altitude, numerical evaluation of log amplitude correlation function for horizontal transmission, and nonhorizontal transmission evaluation. D.E.W.

N64-32764 North American Aviation, Inc., Los Angeles, Calif. Electro-optical Lab.
THE ANGULAR SCINTILLATION CORRELATION FUNCTION
D. L. Fried *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 267–287 ref (See N64-32756 24-08)
(TM-131)

Relations are derived that permit the computation of the angular scintillation correlation function from the phase structure function. D.E.W.

N64-32765 National American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
RMS ANGULAR RESOLUTION BY THE WAVE FRONT APPROXIMATION TECHNIQUE
D. L. Fried *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 288–294 refs (See N64-32756 24-08)
(TM-132)

A formula is derived for the mean squared angular resolution associated with seeing through the atmosphere, and relations are checked by computations and comparison. Results of computation by two different methods are in good agreement with each other and with experimental results. D.E.W.

N64-32766 North American Aviation, Inc., Los Angeles, Calif. Electro-Optical Lab.
ATMOSPHERIC OPTICAL DOPPLER: AN APPROXIMATE EVALUATION
D. L. Fried *In its* Exptl. Laser Space Commun. Program. Task I: Probl. Definition, Vol. II 9 Oct. 1964 p 295–306 refs (See N64-32756 24-08)
(TM-135)

A theoretical derivation of the frequency spreading of an optical signal by atmospheric fluctuations (atmospheric optical doppler) is carried out. The validity of the analysis is restricted by the techniques used to avoid divergent results associated with the cusp at the origin for a five-thirds power structure function. It is concluded that the rms atmospheric optical doppler spread is of the order of 100 cps, though its exact value depends on parameters associated with the measurement conditions. A formula for this dependence is given. Author

N64-32835* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPUTATIONS FOR LARGE, UNIFORM CIRCULAR ARRAYS WITH TYPICAL ELEMENT PATTERNS
Capers R. Cockrell Washington, NASA, Oct. 1964 30 p refs (NASA-TN-D-2105) OTS: $0.75

The general equation describing the total far-field pattern for circular arrays of antennas is derived. By using the equation, fluctuations, obtained by varying the azimuthal angle through 360°, were calculated and plotted as a function of circumference in wavelengths for three typical element patterns. A wide range of circumferences was chosen so that the graphs include frequencies permitting practical circular arrays for space vehicles. The circumference in wavelengths ranges from 1 to 60, and the number of antennas range from 3 to 70. Author

N64-32855 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS. VI: MINI-COST MICROWAVE
Paul Baran Aug. 1964 112 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3762-PR; AD-444835)

This is a feasibility study of a detailed design for the building of microwave equipment used exclusively for a special Distributed Adaptive Message Block Network based on the use of microwave repeater stations. By restricting the system to digital modulation, a reduction in the signal-to-noise ratio is obtained, and so allows the use of microwave transmitters that radiate only 32 milliwatts. Two transmitter designs have been considered—one using small receiving tube klystrons, and the other using a chain of solid-state varactor multipliers, which are the preferred choice. G.G.

N64-32868 Lincoln Lab., Mass. Inst. of Tech., Lexington
FACT SHEET (1963) ON PROJECT WEST FORD
May 1963 11 p Sponsored By AF
(AD-443271)

The West Ford experiment to study the possibility of microwave communication by means of orbiting metallic fibers that act as individual passive-communications satellites is discussed. The individual dipole fibers, the belt of dipoles that will be formed, and the dispenser package are described. Related ground-terminal facilities and measurement techniques developed for Project West Ford have been used to study lunar reflections, for television-picture transmission via passive-communications satellite, and for teletype transmission via lunar reflection. M.P.G.

N64-32901 Joint Publications Research Service, Washington, D.C.
IZVESTIYA VUZov: RADIO ENGINEERING, NO. 3, 1964
21 Oct. 1964 238 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radiotekhn. (Kiev), v. 7, no. 3, May–Jun. 1964 p 265–401
(JPRS-26997; TT-64-51253) OTS: $6.00

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3. SIMPLE METHOD OF TESTING DISCRETE-ACTION ELEMENTS AT HIGH SWITCHING FREQUENCIES M. S. Weyman and G. P. Zemtsov p 30–48 refs (See N64-32904 24-09)

4. USE OF ELECTRONIC ANALOG MACHINES IN THE PRACTICE OF TEACHING A COURSE IN THEORETICAL RADIO ENGINEERING V. A. Lopukhin p 49–58 refs (See N64-32905 24-08)

5. CHOICE OF TRANSMITTER PULSE SHAPE A. G. Golubkov p 59–70 refs (See N64-32906 24-08)

6. INCREASE OF RADIOMETER SENSITIVITY BY NOISE MODULATION OF THE INPUT SIGNAL Yu. Ya. Yurov and V. I. Vinokurov p 71–80 refs (See N64-32907 24-08) 08)

7. STABILITY OF THE Q OF A CIRCUIT WITH INDUCTIVE EFFECT, BASED ON pn JUNCTIONS V. Ye. Prozorovskiy, L. N. Kolesov, and L. L. Afanas'yev p 81–89 refs (See N64-32908 24-09)

8. SYNTHESIS OF BROADBAND VOLTAGE TRANSFORMER B. A. Chekannikov p 90–104 refs (See N64-32909 24-09)

9. CONCERNING THE COMPENSATION OF THE FREQUENCY THERMAL COEFFICIENT OF QUARTZ IN TRANSISTOR SELF-OSCILLATOR CIRCUITS O. T. Sokolov p 105–121 refs (See N64-32910 24-09)

10. USE OF MATCHING TRANSFORMER TO INCREASE FIGURE OF MERIT OF TRANSISTOR AMPLIFICATION STAGES Yu. A. Volkov p 122–134 refs (See N64-32911 24-09)

11. PARAMETRON WITH FERROMAGNETIC FILMS V. A. Sokolov and B. Ya. Fel'dman p 135–147 refs (See N64-32912 24-09)

12. MULTISTAGE CASCODE AMPLIFIER WITH NONLINEAR LOAD E. A. Mel'nikov p 148–158 refs (See N64-32913 24-09)

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14. ESTIMATE OF RELIABILITY OF CERAMIC TUBULAR CAPACITORS M. M. Wekrasov and A. N. Franchuk p 167–174 refs (See N64-32915 24-09)

BRIEF COMMUNICATIONS

15. COMPARATIVE INVESTIGATION OF A VARICAP AND FERROELECTRIC IN THE DECIMETER BAND N. T. Bova p 175–178 refs (See N64-32916 24-09)

16. METHOD AND INSTRUMENT FOR THE MEASUREMENTS OF TRANSMITTED POWER AT MICROWAVE FREQUENCIES V. A. Petrov, L. A. Zubritskiy, A. I. Tereshchenko, and V. Ye. Konovalov p 179–185 refs (See N64-32917 24-09)

17. RIOMETER FOR TWO FREQUENCIES, FOR THE MEASUREMENT OF IONOSPHERIC ABSORPTION Ch. L. Khodzha-Akhmedov p 186–191 refs (See N64-32918 24-15)

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21. SOME FEATURES OF ENERGY SPECTRA OF PULSED RANDOM PROCESSES M. I. Dorman p 206–210 refs (See N64-32922 24-08)

22. INVESTIGATION OF RECOVERY PROCESSES IN THE CIRCUIT OF A GENERATOR OF A LINEARLY-VARYING VOLTAGE WITH POSITIVE FEEDBACK O. P. Nazarov p 211–217 refs (See N64-32923 24-08)

23. CALCULATION OF VOLTAGE OF SELF-OSCILLATOR WITH SELF-BIAS DUE TO GRID CURRENT K. S. Polulyakh p 218–224 refs (See N64-32924 24-09)

24. ON THE 70th ANNIVERSARY OF PROFESSOR S. I. ZILITINKEVICH V. Yu. Roginskiy p 225–227

N64-32902 Joint Publications Research Service, Washington, D.C.
AUTOMATIC SPECTRUM ANALYZERS FOR ELECTRIC SIGNALS
V. G. Kriksunov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 1–18 refs (See N64-32901 24-08) OTS: $6.00

Construction principles and specific characteristics are described for various automatic spectrum analyzers for electric signals in the infrasonic, sonic, and ultrasonic frequency bands. Included are parallel action analyzers with resonators (filter type), sequential action analyzers with resonators (heterodyne), analyzers with preliminary magnetic recording, analyzers without resonators, sequential action analyzers with a recirculator that compresses the signal in time, parallel action analyzers with time variation, as well as other types of analyzers mentioned briefly. M.P.G.

N64-32903 Joint Publications Research Service, Washington, D.C.
SHARPLY DIRECTIONAL RADIATION FROM CONVEX SURFACES
D. I. Voskresenskiy *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 19–29 refs (See N64-32901 24-08) OTS: $6.00

The distribution of current on a specified convex surface, such as to insure sharply directional radiation, is considered. A connection is established between the current density on the radiating surface and the field in an equivalent flat aperture. The limits are determined within which the directivity patterns

of a convex surface and of the equivalent aperture coincide. The influence of the conducting surface on the radiation field of the specified current is determined approximately. Author

N64-32905 Joint Publications Research Service, Washington, D.C.
USE OF ELECTRONIC ANALOG MACHINES IN THE PRACTICE OF TEACHING A COURSE IN THEORETICAL RADIO ENGINEERING
V. A. Lopukhin *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 49–58 refs (See N64-32901 24-08) OTS: $6.00

General problems are considered that are connected with the use of electronic analog machines in the practice of teaching a course in theoretical radio engineering. The principle of exposition of the lecture material is considered with the study of a parametric oscillating circuit as an example. A list of radio processes, the theory of which is best taught using electronic analog machines, is given. Author

N64-32906 Joint Publications Research Service, Washington, D.C.
CHOICE OF TRANSMITTER PULSE SHAPE
A. G. Golubkov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 59–70 refs (See N64-32901 24-12) OTS: $6.00

The question is considered of permissible deviations of the shape of transmitter pulses from optimal in a system of functional tolerances. By optimal shape is meant a pulse shape that insures maximum concentration of energy in time and in frequency. The results obtained are suitable for engineering calculations. It is indicated that the introduction of a system of functional tolerances can be effectively employed in related radio technical disciplines. Author

N64-32907 Joint Publications Research Service, Washington, D.C.
INCREASE OF RADIOMETER SENSITIVITY BY NOISE MODULATION OF THE INPUT SIGNAL
Yu. Ya. Yurov and V. I. Vinokurov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 71–80 refs (See N64-32901 24-08) OTS: $6.00

It is shown that the use of input-signal modulation in accordance with a noise law, with subsequent connection of a correlator constructed on the principle of a linear system with variable parameters, makes it possible to increase the sensitivity of a radiometer. Author

N64-32919 Joint Publications Research Service, Washington, D.C.
INTERFERENCE IMMUNITY OF A DIVERSITY RECEPTION SYSTEM WITH ANTENNA SWITCHING
A. G. Zyuko *In its* Izv. VUZov: Radio Eng., No. 3, 1964 11 Oct. 1964 p 192–195 refs (See N64-32901 24-08) OTS: $6.00

From mathematical computations, the author concludes that the interference immunity of the antenna switching system depends essentially on the choice of the threshold, which depends on the ratio of the signal to the noise. When the threshold is correctly chosen, the interference immunity of the antenna switching system is comparable with the interference immunity of the receiver switching system. A.W.

N64-32920 Joint Publications Research Service, Washington, D.C.
CLASSIFICATION OF CONVERTERS OF CURVES INTO ELECTRIC SIGNALS
A. I. Petrenko and V. K. Yeliseyev *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 196–200 refs (See N64-32901 24-08) OTS: $6.00

The authors consider the subdivision of plot converters in accordance with the class of the converted function to be the most general classification of converters. They describe several conversion methods, and conclude that, on the basis of a universal digital computer, one can construct some universal graph converter with which can be realized any of the described conversion methods. A.W.

N64-32921 Joint Publications Research Service, Washington, D.C.
USE OF PERIODIC SAMPLING FOR THE DETERMINATION OF PROBABILITY DISTRIBUTION FUNCTIONS
V. S. Gorbenko *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 201–205 refs (See N64-32901 24-08) OTS: $6.00

In the determination of statistical parameters of sampling functions (realizations) of random processes, [periodic sampling is frequently used], which is realized by reading the values of the sampling function at equal time intervals t_0 (where t_0 is the sampling period). Over the total measurement time, $N = T/t_0$ is the sampling of values. Periodic sampling and statistical processing of sampling values can be performed successfully by means of specialized digital computers. In this connection, such problems as the determination of the minimum volume of the sampling (T and N), at which sufficient reliability and accuracy of the statistical analysis results, are raised. Other questions raised are the determination of the random errors for a given volume of sampling, the determination of random and systematic errors introduced by the electronic computer, etc. Author

N64-32922 Joint Publications Research Service, Washington, D.C.
SOME FEATURES OF ENERGY SPECTRA OF PULSED RANDOM PROCESSES
M. I. Dorman *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 206–210 refs (See N64-32901 24-08) OTS: $6.00

A random sequence of pulses u(t) of identical waveform is considered. The pulse sequences are modulated by stationary processes. In particular, the sequence considered is the process that is produced at the output of some pulse generator, which in general consists of linear and nonlinear elements. Establishing the degree of mutual dependence of the random parameters on the basis of physical considerations is discussed. It is concluded that the degree of mutual correlation of individual intervals of a random process exerts no influence on its energy spectrum. P.V.E.

N64-32934 Mitre Corp., Bedford, Mass.
SIMPLIFIED POINTING EQUATIONS FOR SLAVING AN ANTENNA TO THE RADAR COORDINATES
R. Manasse Sep. 1963 9 p
(Contract AF 19(628)-2390)
(TM-3646; ESD-TDR-63-492; AD-601781) OTS: $1.00

This paper derives approximate expressions for the radar coordinates of a target at a slave site in terms of its radar coordinates at a master site. The equations are specialized to the important case where the two sites differ only in longitude, so that it is convenient to apply these equations to obtain the pointing angle corrections introduced by earth rotation. Author

N64-32966 Lockheed Missiles and Space Co., Sunnyvale, Calif.
RADAR SIMULATION: AN ANNOTATED BIBLIOGRAPHY

George R. Evans, comp. Jun. 1964 77 p refs *Its* Rept.-2-60-64-28
(Contract NOw-63-0050-c)
(SB-64-12; AD-449498)

The subject of the search is limited generally to radar simulation by computers—either analog or digital techniques. Excluded for the most part are those references dealing with simulation by electronic modeling. The search covers the period 1956–June 1964 for open literature and 1953–June 1964 for report literature. Author

N64-32972 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ELECTRONIC COUNTERMEASURES AND COUNTER-COUNTERMEASURES: AN ANNOTATED BIBLIOGRAPHY Supplement II, Jun. 1963–Jun. 1964
Peter R. Stromer, comp. Jul. 1964 107 p refs *Its* Rept.-2-60-64-32
(Contract NOw-63-0050-c)
(SB-64-13; AD-448090)

Emphasis is on active ECM devices and techniques, especially as related to reentry vehicle penetration aids. Entries are arranged alphabetically by corporate source, with both a detailed subject index and a personal author index included. Author

N64-32997* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
HIGH-POWER CW RADAR TRANSMITTER
Walter S. Baumgartner 1 Sep. 1964 30 p
(Contract NAS7-100)
(NASA-CR-58801; JPL-TR-32-656) OTS: $2.00 fs; $0.50 mf

This report is principally a description of an operational high-power cw radar transmitter. Some preliminary discussion of the space telecommunications problem, the existing Deep Space Network, and, in particular, the continuing program of advanced system development is presented. The system in which the transmitter functions is described, and its use as a planetary radar and as a proving ground for equipment is discussed. The design parameters for such a transmitter are delineated, and the history of its development is traced. Particular attention is given to problems encountered and to their solutions. There is a detailed description of the hardware involved. Author

N64-33017 Stanford U., Calif. Stanford Electronics Lab.
PROPAGATION OF VLF RADIO WAVES ACROSS THE AURORAL ZONE Technical Report No. 1
Eigil Ungstrup Jun. 1964 24 p refs
(Grant NSF-GA-56)
(SU-SEL-64-051)

Whistler observations at Godhavn, Greenland, show a peak in activity shortly before local noon, whereas at most other stations the activity peaks during the night. An investigation of this disagreement between expected and observed diurnal variation has revealed that the whistlers observed at Godhavn usually originate close to the west coast of the United States and propagate from there to Godhavn under the ionosphere. This is shown both by comparison of rate curves from different longitudes in the Northern Hemisphere and by detailed comparison of single events. The fact that whistlers propagate to Greenland from the west coast of the United States, but not from the nearer areas at same magnetic latitude south and southeast of Godhavn, suggests that Godhavn is screened from audio-frequency radio waves arriving from certain directions. An absorption area, caused by increased particle precipitation along the auroral zone south and east of Greenland, is suggested as explanation. Author

N64-33028 Illinois U., Urbana, Ill. Antenna Lab.
MEASUREMENTS OF FAR-FIELD RADIATION PATTERNS IN THE NEAR-FIELD OF A RADIATING LENS FED WITH A GOUBAU BEAM-WAVEGUIDE
J. F. Kauffman Jul. 1964 10 p refs
(Contract AF 33(657)-10474)
(TR-81; AD-603172)

Radiation patterns are presented showing that correcting lenses placed flush with the radiating lens of the test antenna give acceptable reproductions of the far-field patterns at design points in the near field. However, is the test-antenna aperture is constructed so that it is impossible to get the correcting lens close to it, the correcting lens is of very little use because it begins to look like a source as its distance from the test aperture is increased. M.P.G.

N64-33073 Bendix Corp., Baltimore, Md. Bendix Radio Div.
SATELLITE COMMUNICATIONS TRANSPORTABLE GROUND TERMINAL. VOLUME I: COMMUNICATIONS EQUIPMENT Final Report, 9 Dec. 1961–1 Sep. 1963
G. E. Sanner Sep. 1963 384 p refs
(Contract DA-36-039-SC-87504; Proj. SYNCOM)
(SYN-52-07-01; AD-444240)

This report describes the design, construction, and testing of the SYNCOM ground terminal. The ground station equipment for Project SYNCOM is located in trailer-vans, thus making the system road and air transportable. A 7-Gc signal is transmitted at 20 kW, received and retransmitted at 2 Gc by the satellite, and returned to the ground where it is amplified by the low noise receiving equipment. The satellite is located, acquired, and tracked automatically by the ground antenna. The system can be operated in one of three modes—manual, remote, or auto acquire. System power is provided by three diesel engine-generator vans, each supplying 200 kW of cw power. Thus the entire ground terminal is completely self-sufficient. Author

N64-33094* Stanford Research Inst., Menlo Park, Calif.
STUDY OF THE BREAKDOWN CHARACTERISTICS OF ANTENNAS IN THE ATMOSPHERES OF MARS AND VENUS Final Report
J. A. Martin and J. Chown Feb. 1963 30 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950380)
(NASA-CR-59111) OTS: $2.00 fs; $0.50 mf

The objective of this study was to determine the power-handling capability and breakdown-power level of several typical linear and circularly polarized antennas in the simulated atmospheres of Mars and Venus. For the N_2, CO_2, and Ar concentrations forming the simulated atmospheres employed here, the breakdown power level of the antennas was not significantly different from that experienced in air. Measured power required to initiate breakdown of 0.26 λ cylindrical monopole antennas is presented for Ω = 13.8, 12.0, 10.6, 10.1, 9.2, 7.8, 6.0, and 5.0 [Ω = 2 ln (4 length/diam) of antenna]. Measured breakdown power as a function of pressure is presented also for a cylindrical dipole antenna. The antenna scaling principle was verified at frequencies of 250 Mc (CW), 1197 Mc (pulse), and 3000 Mc (pulse), using monopole antennas of different thickness ratio, Ω. Author

N64-33106 Cubic Corp., San Diego, Calif.
MATTS EVALUATION STUDY Final Report
Aug. 1964 386 p refs
(Contract AF 08(635)-3838)
(ATL-TDR-64-57, Vol. 1, Pt. 1; AD-449698)

The scoring accuracy summary over the MATTS scoring volume is presented graphically in the form of contours of

equal miss and escape error. Engineering studies included an objective reexamination of all present Bendix G-15D programing, a comprehensive study of the MATTS system calibration, and a mathematical and experimental analysis of the electronic phasemeter servos. System modifications comprised the following: replacing the present tracking antennas with weatherproof, broadband units of similar electrical properties to the original antennas; electrically matching all antenna field rf cables by pairs; and reprograming the scoring and fire control analysis computations. Author

N64-33116* Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOGUE OF SATELLITE OBSERVATIONS NO. C-37
Beatrice Miller 16 Jun. 1964 48 p refs
(Grant NsG-87-60)
(NASA-CR-59174; SAO Special Rept.-153) OTS: $2.00 fs; $0.50 mf

Observation data are presented for satellites for the period January 1 through June 30, 1963—1958 alpha 1, 1959 Alpha 1, 1959 Eta 1, and 1959 Iota 1. Data include this information: (1) month, day, and time of observation; (2) right ascension; (3) declination; (4) azimuth; and (5) altitude obtained by various stations. P.V.E.

N64-33117* Smithsonian Astrophysical Observatory Cambridge, Mass.
CATALOGUE OF SATELLITE OBSERVATIONS NO. C-38
Beatrice Miller 17 Jun. 1964 88 p refs
(Grant NsG-87-60)
(NASA-CR-59142; SAO Special Rept.-154) OTS: $3.00 fs; $0.50 mf

Listed are field-reduced observations of Satellite 1960, Iota 1 (Echo I), Sattelite 1960 Iota 2 (Echo I rocket), Satellite 1960 Xi 1 (Explorer VIII), and Satellite 1961 Delta 1 (Explorer IX) for the period January 1–June 30, 1963. R.L.K.

N64-33118* Smithsonian Astrophysical Observatory Cambridge, Mass.
SATTELLITE ORBITAL DATA
I. G. Izsak et al 17 Jul. 1964 68 p
(Grant NsG-87-60)
(NASA-CR-58842; SAO Special Rept. 159) OTS: $3.00 fs; $0.50 mf

A tabulation is listed of differential orbits from April 1 through September 2, 1963, for 1958, 1959, 1960, and 1961 satellites. These reports continue to provide a rapid distribution of catalogs for satellite observations, orbital information, and preliminary results of data analyses prior to formal publication. E.C.

N64-33135* Smithsonian Astrophysical Observatory, Cambridge, Mass.
OPTICAL SATELLITE TRACKING PROGRAM Semiannual Progress Report No. 8, Jan. 1–Jun. 30, 1963
Fred L. Whipple [1963] 34 p refs
(Grant NsG-87)
(NASA-CR-55652)

This report includes a discussion of the prototype of the EECo precision-timing-system tests, operation of equipment at the tracking stations, instrumentation studies, communications, data processing, and data utilization. E.C.

N64-33182* Smithsonian Astrophysical Observatory, Cambridge, Mass.
SATELLITE ORBITAL DATA NO. E-4
I. G. Izsak 10 Jul. 1964 35 p
(Grant NsG-87-60)
(NASA-CR-58841; SAO Special Rept.-158) OTS: $2.00 fs; $0.50 mf

Tabulations of differential orbits are listed from July 1, 1962, through December 30, 1962, for 1959, 1960, 1961, 1962 satellites. These reports provide a rapid distribution of catalogs of satellite observations, orbital information, and preliminary results of data analyses prior to formal publication. E.C.

N64-33193* General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
DOCUMENTATION OF SATURN RF AND TELEMETRY CHECK OUT PROCEDURES FOR THE ELECTRONIC ENGINEERING MEASURING AND TRACKING OFFICE AT THE LAUNCH OPERATIONS CENTER
W. J. Mitchell and R. F. Meyer 6 Feb. 1963 105 p
(Contract NASw-410)
(NASA-CR-58964) OTS: $4.00 fs; $0.75 mf

A study of telemetry and rf checkout philosophy and procedures is presented. The study considered the following: (1) equipment checkout at the launch operations center—telemetry, Azusa II precision electronic tracking system, uhf doppler and position-measuring system, C-band beacon, and command receiver; (2) the C-1 block II equipment—radar altimeter, digital command systems, AROD tracking system, missile-trajectory measurement system, television system, and digital-data acquisition system; and (3) the C-5 planning—rf and telemetry checkout, automation, future telemetry and tracking development, and tracking systems. P.V.E.

N64-33204* Ryan Electronics, San Diego, Calif.
RYAN MODEL 534 VEHICLE RANGE EXTRACTION UNIT Final Report
N. L. Olthoff and H. T. Hoffman 1 Mar. 1964 62 p *Its* Rept.-53463-8
(Contract NAS8-5481)
(NASA-CR-58885) OTS: $3.00 fs; $0.75 mf

The equipment includes a continuous wave transmitter that communicates with multiple, unattended ground transponder stations to provide precision vehicle position and velocity. Range and velocity measurements are made with respect to three or more precisely located transponder stations. The velocity of the vehicle relative to a ground transponder station is determined by measuring the doppler frequency shift of the coherent carrier transmitted from the vehicle to the transponder and back. The range of the vehicle relative to the transponder station is determined from the signal propagation time delay and is measured by the VREU by phase comparisons between the transmitted and received modulation tones on the carrier. These measurements are time labeled and either telemetered to earth or used directly to compute the actual position and velocity of the vehicle in orbit. Author

N64-33206* Electronic Communications, Inc., Timonium, Md. Research Div.
TECHNIQUES FOR SUPERHETERODYNE RECEIVERS ABOVE 100 GIGACYCLES Final Report
M. Cohn, R. F. Packard, J. W. Dozier, J. D. Rogers, and A. F. Eikenberg 14 Apr. 1964 104 p refs
(Contract NASw-662)
(NASA-CR-58947) OTS: $4.00 fs; $0.75 mf

The principle of operation, methods of fabrication, and experimental results are presented for a ferroelectric device capable of measuring absolute power at millimeter and submillimeter wavelengths. The results of a statistically designed diode evaluation program are given. A description is given of

an improved technique for the fabrication of millimeter waveguide and movable shorting plungers. A report is made on the performance data obtained for point-contact semiconductor devices such as conventional mixers, harmonic mixers, and harmonic generators. Improvements in the design and performance of a 2-mm ferrite modulator employing the principle of faraday rotation are reported. Author

N64-33226 Joint Publications Research Service, Washington, D.C.
PROBLEMS IN WAVE-DIFFRACTION AND PROPAGATION. VOLUME II: RADIO-WAVE PROPAGATION, NO. 2
Z. I. Tsar'kova, ed. 28 Oct. 1964 235 p refs Transl. into ENGLISH of "Problemy Difraktsii i Rasprostraneniya Voln. Rasprostraneniye Radio-Voln, nr. 2" Leningrad State U., 1962 p 1–217
(JPRS-27125; TT-64-51381) OTS: $6.00

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N64-33227 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS. II: DIGITAL SIMULATION OF HOT-POTATO ROUTING IN A BROADBAND DISTRIBUTED COMMUNICATIONS NETWORK
Sharla P. Boehm and Paul Baran Aug. 1964 57 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3103-PR; AD-444834)

The small-memory, stochastic, hot-potato routing scheme has been simulated on the IBM 7090 computer, using FORTRAN language. The simulation has shown that an efficient store-and-forward routing doctrine can be performed in a distributed network using a relatively simple policy at each switching node. The computer program simulated real-time operation of the network, with a time factor of about 540 seconds of computer-time to one second of real-time operation. Network learning time was determined as a function of traffic volume, redundancy of connection, and maximum allowable handover number. From a dead start, a 49-node network can learn to route messages very effectively within about one second of scaled real-world time. The traffic-handling capacity of the network was examined, and it was found that loadings on the order of about 50% of peak capacity were possible without excessively increasing the transmission path length or delay time. Author

N64-33228 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS. III: DETERMINATION OF PATH-LENGTHS IN A DISTRIBUTED NETWORK
J. W. Smith Aug. 1964 101 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3578-PR; AD-444833)

Results of investigations into the behavior of distributed communications networks under various loading conditions are reported. A mathematical model and a deterministic equation for predicting the distribution of message path lengths are derived and evaluated. A SCAT-encoded simulation program that corrects deficiencies of earlier simulations is described. An "input-choking" doctrine together with a short, purposeful delay of messages passing through each station (when necessary), proved to be a powerful device in preventing loss of messages within networks operating at high loading ratios. The decrease in delay and in message-flow rate caused by the doctrine was negligible. Author

N64-33229 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS. IV: PRIORITY, PRECEDENCE, AND OVERLOAD
Paul Baran Aug. 1964 72 p refs
(Contract AF 49(638)-700); Proj. RAND)
(RM-3638-PR; AD-444840)

This memorandum considers four separate techniques that can be used singly or in combination to achieve, through automation, "best" use of a seriously degraded and overloaded communications plant, within the framework of a rapidly changing organizational structure. Precedence is determined moment-by-moment, automatically for all traffic in the network. Precedence is computed as a composite function of the following: (1) the ability of the network to accept additional traffic; (2) the "importance" of each user and the "utility" of his traffic; (3) the data rate of each input transmission medium or the transducer used; and (4) the tolerable delay time for delivery of the traffic. During overload conditions, precedence status information is fed back through the network to limit the type and volume of data flow allocated to each user.

Author

N64-33230 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS. VII: TENTATIVE ENGINEERING SPECIFICATIONS AND PRELIMINARY DESIGN FOR A HIGH-DATA-RATE DISTRIBUTED NETWORK SWITCHING NODE
Paul Baran Aug. 1964 97 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3763-PR; AD-444832)

This memorandum details the description of and the design specifications for the distributed adaptive message block network switching node. Documentation is presented to verify that the necessary computer operations can be performed within the prescribed timing constraints of limited circuitry, and the equipment components count is determined. The

switching node is capable of operating at nonsynchronous data rates of up to 1.54-million bits per second per link (with simultaneous input and output, and at a redundancy level of four). It would appear that such a node can be built within the present state-of-the-art, employing digital computer techniques. Author

N64-33231 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS. VIII: THE MULTIPLEXING STATION
Paul Baran Aug. 1964 115 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3764-PR; AD-444831)

The multiplexing station feeds the switching nodes and constitutes the interface between the users and the network. Each station is able to accept a mixture of start-stop teletype signals; 600-, 2400-, 9600-, 19200-bit/sec synchronous signals; and a limited number of highly intermittent megabit/sec signal subscribers. It is able to simultaneously process traffic from a maximum of 1024 separate users, connected into any single Switching Node. The multiplexing station is comprised of a magnetic drum, a magnetic core store, and necessary special-purpose transistorized digital processing equipment, occupying about 150 ft^3. In addition to detailed descriptions of the components and the operations of the station, some engineering specifications, flow charts, and computational criteria are included. Author

N64-33234 Illinois U., Urbana Radiolocation Research Lab.
EXPERIMENTAL STUDY OF MUTUAL COUPLINGS BETWEEN ELEMENTS OF A WIDE APERTURE RADIO LOCATION ANTENNA Technical Report No. 3
Fred Ore Jun. 1964 21 p refs
(Contract NObsr-89229)
(RRL-246; AD-603196) OTS: $2.00

It was decided to determine experimentally the approximate effect of the mutual coupling between a single element and the immediate adjacent elements on either side. Since the mutual coupling between elements of an array ordinarily affects the impedance of the array more than the radiation performance, it was decided to use the impedance approach. First, a good impedance model of a typical element was constructed and tested. Then, the measured impedance of this single model was used as a standard to compare with the impedance of the same model when arrayed with additional elements on either side. The investigation demonstrated some of the effects of mutual coupling on the impedance characteristics of an element of the large circular array being considered. It was shown that the minimum practical spacing between phase centers of adjacent elements of the array is on the order of $3\lambda/16$. D.E.W.

N64-33251 Gt. Brit. Dept. of Scientific and Industrial Research Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: JUNE 1964
1964 29 p *Its* Issue 14

This report contains kinetheodolite observations during June 1964 of the following satellites: Sigma 1 (Midas 3) 1961, Kappa 1 (Midas 5) 1962, Beta–Alpha 2 (Alouette rocket) 1962, Beta–Kappa (Starad) 1962, and Beta–Mu 2 (Anna 1B rocket) 1962. E.C.

N64-33252 Gt. Brit. Dept. of Scientific and Industrial Research Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: June 1964
1964 33 p *Its* Issue 15

This report contains tabulated kinetheodolite observations during June 1964 of 09A (Explorer XVII) 1963, 14A (Midas VI) 1963, 30A (Midas VII) 1963, 30D (Atlas Agena B) 1963, 43A (Poljet/1 Sat) 1963, 53A (Explorer XIX) 1963, and 04A (Echo II satellite) 1964. E.C.

N64-33253 Gt. Brit. Dept. of Scientific and Industrial Research Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: DECEMBER 1963
1964 24 p *Its* Issue 16

This report contains kinetheodolite observations during December 1963 of the following satellites: Kappa 1 (Midas 5) 1962, Beta–Chi (Explorer 16) 1962, 14A (Midas 6) 1963, 27A (Agena) 1963, 30A (Midas 7) and 38A 1963. E.C.

N64-33307 New York U., N.Y. Courant Inst. of Mathematical Sciences
THE DIFFRACTION OF OBLIQUE SURFACE WAVES BY A RIGHT-ANGLE BEND
S. N. Karp and T. S. Chu Jul. 1964 30 p refs
(Contract AF 19(628)-3868)
(EM-190; AFCRL-64-599; AD-606513)

The diffracted field that arises when an incident electromagnetic surface wave strikes the edge of a right-angle bend at an oblique angle is investigated. One face of the bend supports the surface wave, and the other face is a perfect conductor. This diffraction problem is related to the scanning surface wave antennas. An analysis of oblique surface waves on an infinite impedance plane is presented graphically. Two cases are treated. In one case the edge of the bend is parallel, and in the other case, perpendicular, to the perfectly conducting direction of the impedance plane. When the surface wave is incident normally, these special cases reduce to the normal TM and TE surface waves respectively. Author

N64-33319 Lincoln Lab., Mass. Inst. of Tech., Lexington
SPECTRA OF VOCODER CHANNEL SIGNALS Group Report 1964–17
C. M. Rader 4 May 1964 21 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-58; AD-600185)

A channel vocoder derives the short-time magnitude spectrum of speech by passing the speech through a set of analyzing channels, each consisting of a bandpass filter followed by an envelope detector and a low pass filter. Each channel produces a slowly varying output signal that represents a short-term average of the speech energy in the corresponding frequency band. The measurement of the power spectra of these signals is described. These signals may be thought of as band limited to 25 cps. Author

N64-33359 Aberdeen Proving Ground, Md. Ballistic Research Labs.
A TECHNIQUE FOR MEASURING DISPERSIVE DOPPLER FREQUENCY IN CONJUNCTION WITH THE S-66 POLAR BEACON SATELLITE

H. Raub Jul. 1964 17 p refs
(BRL-MR-1579; AD-450457)

The S-66 Ionospheric Beacon Satellite is designed specifically to provide a means of obtaining ionosphere data such as columnar electron content, irregularities in the ionosphere and profile of electron density, which are derived from faraday rotation and dispersive doppler frequency measurements. These measurements will be possible throughout most of the world due to the orbit selected for the experiment. A system is used that comprises complex antennas, highly sensitive receivers with their associated tracking filters, and a variety of data circuits to measure the effects of the ionosphere on the doppler shift produced by the high velocity of the satellite with respect to a ground station. In addition, a 10-kc bias is inserted on the dispersive doppler frequency, which defines a sense of direction, hence reducing the possibility of error that could normally occur as the dispersive doppler goes through zero frequency. Author

N64-33363 University of Southern Calif., Los Angeles School of Engineering
A CORRELATION THEORY FOR FORWARD SCATTERING PROCESSES
I. S. Reed and R. A. Scholtz May 1964 31 p refs
(Contract AF 04(695)-304)
(USCEE-110; SSD-TDR-64-192; AD-444342)

A model for the received signal in a two-antenna system relying on forward scattered signals is derived in terms of geometry, antenna patterns, scatterer characteristics, and transmitted modulating waveform. The correlation function for the received signal is derived using probabilistic information about scatter position, velocity, and orientation. The channel function is derived explicitly and interpreted in terms of the power-dispersing effects of the channel in both time and frequency. Author

N64-33372 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS. IX: SECURITY, SECRECY, AND TAMPER-FREE CONSIDERATIONS
Paul Baran Aug. 1964 48 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3765-PR; AD-444839)

The Distributed Adaptive Message Block Network is proposed in Volume I of this series as a digital-data communications system based on a distributed network concept. The security aspects of such a system are considered, with some key principles being description of the proposed system in the open literature, integration in design of security provisions into the switching network, inclusion of various combinations of cryptographic techniques, and an initial system design that assumes potential infiltration by enemy agents having access to portions of the system and the cryptographic key bases. D.E.W.

N64-33411 General Dynamics/Fort Worth, Tex.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A TECHNIQUE FOR REDUCING EXTRANEOUS SIGNALS IN RADAR SCATTERING MEASUREMENTS
W. P. Cahill and C. C. Freeny Griffiss AFB, N.Y., RADC, Jul. 1964 253 p refs
(Contract AF 30(602)-2831)
(FZE-222-8; RADC-TDR-64-418; AD-607136)

An experimental system for analytically reducing the influence of target supports was implemented by incorporating a phase measurement system and a digital computer into an operational radar cross-section measurement facility. Data were obtained by using the system to reduce the influence of the return of Styrofoam support columns during the measurement of 1/2-, 5/8-, 7/8-, and 2-in.-diam spheres and a 30°, 5.1-in.-diam sphere–cone as targets at L-band. A cross-section measurement error of about 7 dB, resulting from the influence of the target support system, was reduced to about 1 dB by using this discrimination system in the vicinity of nose-on in the case of the sphere–cone target. Author

N64-33416 Royal Inst. of Tech., Stockholm (Sweden)
SPEECH SPECTRUM ANALYSIS TECHNIQUES Final Technical Report, 1 Aug. 1963–31 Jul. 1964
C. Gunnar Fant [1964] 109 p refs
(Contract DA-91-591-EUC-3080)
(Rept.-4; AD-448201)

Research carried out with regard to the following is summarized: (1) Speech Analysis—spectrum analysis instrumentation, spectrographic data, voice source studies, segment duration; (2) speech production—the sine wave response of the vocal tract, the role of the vocal cavity walls in speech, and articulatory activity in vowels; and (3) Speech Perception—two formal vowel approximations and French intonation. P.V.E.

N64-33428 Colorado U., Boulder
MODEL STUDIES OF THE INFLUENCE OF IONOSPHERE PERTURBATIONS ON VLF PROPAGATION Technical Summary Report, 1 Jan. 1962–1 Jan. 1963
S. W. Maley and E. Bahar [1963] 93 p refs
(Contract NBS CST-7348; ARPA Order 183-62)
(AD-420379)

The effect of changes in the height of the ionosphere on VLF propagation in the waveguide between the earth and the ionosphere is investigated theoretically and experimentally. Theoretically, the problem is that of solving for the propagation within a waveguide of changing dimensions and of a size large enough to propagate a number of modes. Experimental models are devised to gain information as to the effect of perturbations in the ionosphere as well as to prove or disprove the validity of approximate mathematical solutions. D.S.G.

N64-33446 Gt. Brit. Dept. of Scientific and Industrial Research Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: MAY 1964
1964 25 p *Its* Issue 12

N64-33447 Gt. Brit. Dept. of Scientific and Industrial Research Radio Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA: MAY 1964
1964 31 p *Its* Issue 13

N64-33466 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
PASSIVE MEASUREMENTS STUDY
Robert A. Voss and Charles W. Williston May 1964 5 p refs
(USA-ERDA-116; AD-444990)

This report describes the experiments performed to investigate the feasibility of missile tracking by use of continuous-wave reflection tracking techniques. Experimental versions of both doppler and radio interferometer configurations were operated. The advantages of eliminating missile-borne transponders are considerable for missile-range operation. Shortcomings in data quality are discussed. Similar systems based

on this same principle of operation are briefly described. Descriptions of equipment, tests, data reduction procedures, and data selected for analysis are included. Author

N64-33477 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
HIGH-TEMPERATURE ANTENNA INVESTIGATION Interim Engineering Report, No. 5 Period Ending 30 Jun. 1964
G. F. Buranich [1964] 55 p refs
(Contract AF 33(657)-11100)
(CAL-UB-1807-E-5; AD-602842)

This report summarizes investigations that were made for developing antennas suitable for prolonged operation at a temperature of 2000° F. The efficiencies of S-band helical antennas made of various metals were compared, and no significant reduction in efficiency occurred with metals having resistivities as high as 120μohm - cm. Tests made on nichrome and coated tantalum helical antennas at 2000° F showed no degradation with temperature. Author

N64-33518 Gt. Brit. Dept. of Scientific and Industrial Research Radio Research Station
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE
May 1964 35 p

N64-33527 Army Signal Research and Development Agency, and Lab., Fort Monmouth, N.J.
APPRAISAL OF CO-SITE INTERFERENCE AND EFFICIENCY OF THE abm FREQUENCY PLAN
Nello R. Castellini Jul. 1963 38 p refs
(USAELRDL-TR-2377; AD-607399)

To be free of spurious interference, any frequency assignment whatsoever must be drawn from frequency groups, the members of which belong to the logical product of classes of frequencies defined in conjunction with the mutual interference chart (MIC). If this condition is not met, the groups contain potential interferers that, in frequency assignments, may form combinations giving rise to spurious interference with definite probabilities that various degrees of interference will be encountered. An experimental MIC and an abm frequency assignment are examined in the light of the theoretical results. The abm plan has the advantage of relative simplicity, but is wasteful of useful frequency combinations, and provides assignments that, especially at low frequencies (in units of the intermediate frequency), are likely to contain interference. The computations performed show what a devastating effect even a few interfering combinations have if several assignments are made. The results emphasize the need and value of the theory of classes to attain the correct solution of the problem of assignment. Author

N64-33533 Santa Rita Technology, Inc., Menlo Park Calif. Bioacoustics Lab. Div.
COMMUNICATION WITHOUT (CONVENTIONAL ELECTROMECHANICAL) ACOUSTIC TRANSDUCERS Technical Documentary Report, 1 Jun. 1963–30 Sep. 1964
Robert L. Lucas, John L. Stewart, and E. James Kreul Wright-Patterson AFB, Ohio, AF Avionics Lab., 30 Sep. 1964 75 p refs
(Contract AF-33(657)-11591)
(AL-TDR-64-243; AD-606830)

Touch and vibration sensations accompanying the act of speaking provide a series of typical afferent neural signals associated with speech. These sensations can be evoked at other locations on the body by electromechanical transducers. Substitute tactile sensations are subjectively acceptable in lieu of their real counterparts, and the tactile recognition of a speech form is accomplished by association when artificial "speech taction" is generated in the palmar surface of the hand. Palmar stimulation is effected with pulses of electrical energy transduced to mechanical form, which in turn produce epidermal strain analogous to the subjective tactile sensations of speech. Author

N64-33534 Purdue Research Foundation, Lafayette, Ind.
THE THEORETICAL AND NUMERICAL DETERMINATION OF THE RADAR CROSS SECTION OF A FINITE CONE Scientific Report No. 1
F. V. Schultz, G. M. Ruckgaber, S. Richter, and J. K. Schindler Aug. 1964 54 p refs
(Contract AF 19(628)-1691)
(TR-EE64-14; AFCRL-64-658; AD-606828)

This investigation of the radar cross section of a finite cone can be divided into three areas as follows: (1) The exact solution for the scattering of a plane electromagnetic wave by a finite cone is presented. Rigorous electromagnetic theory is used in the solution, and no approximations are made. (2) Methods of obtaining numerical results for the radar cross section from the analytic solution by using a digital computer are discussed. (3) The numerical results are discussed. Author

N64-33537 International Business Machines Corp., Bethesda, Md. Federal Systems Div.
ERROR CONTROL THROUGH CODING. VOLUME I: SUMMARY OF RESULTS Final Report, Mar. 1963–Mar. 1964
Griffiss AFB, N.Y., RADC, Jul. 1964 40p refs
(Contract AF 30(602)-2958)
(RADC-TDR-64-149, Vol. I; AD-607523)

This research was primarily devoted to the application of error-control techniques. This discipline has developed a body of knowledge that can be extremely valuable to communication systems designers if criteria for the use of error-control coding can be developed. The work included an analysis of channel statistics that leads to a computer program designed to choose an optimum error-control technique from standard channel statistics and data transmission parameters. Variable length, variable redundancy codes, and their applications were studied. Comparisons of block and recurrent codes were made; in addition a study was made of error propagation in recurrent codes. A cyclic decoding procedure for the familiar Bose–Chaudhuri-Hocquenghem code was developed. Author

N64-33538 International Business Machines Corp., Bethesda, Md. Federal Systems Div.
ERROR CONTROL THROUGH CODING. VOLUME II: RECURRENT BURST-ERROR-CORRECTING CODES Final Report
C. V. Freiman, J. P. Robinson, and A. D. Wyner Griffiss AFB, N.Y., RADC, Jul. 1964 236 p refs
(Contract AF 30(602)-2958)
(RADC-TDR-64-149, Vol. II; AD-607583)

The work performed fell into four major categories: (1) lower bounds on the redundancy of recurrent codes; (2) upper bounds on the redundancy of recurrent codes; (3) comparisons of block codes and recurrent codes; and (4) error propagation in recurrent codes. Author

N64-33539 International Business Machines Corp., Bethesda, Md. Federal Systems Div.
ERROR CONTROL THROUGH CODING. VOLUME III: VARIABLE REDUNDANCY CODES Final Report
R. T. Chien and D. T. Tang Griffiss AFB, N. Y. RADC, Jul. 1964 89 p refs
(Contract AF 30(602)-2958)
(RADC-TDR-64-149, Vol. III; AD-607524)

The main results of the research work on variable redundancy codes fall into the following categories: (1) classes of variable redundancy codes; (2) implementation of variable redundancy codes; and (3) mode control of variable redundancy codes. Basic terminology, notations, and conventions used throughout the work, and results are reported. Author

N64-33540 International Business Machine Corp., Bethesda, Md. Federal Systems Div.
ERROR CONTROL THROUGH CODING. VOLUME IV: RESIDUE CODES Final Report
R. T. Chien Griffiss AFB, N.Y., RADC, Jul. 1964 80 p refs
(Contract AF 30(602)-2958)
(RADC-TDR-64-149, Vol. IV; AD-607525)

Residue code study results are presented in the following areas: (1) residue codes for burst-error correction, including a general theory that can be used to treat the binary and nonbinary cases within the same mathematical framework and that does not require an exact value for the radix; (2) new decoding procedures for Bose–Chaudhuri–Hocquenghem codes, including both a sequential procedure and a cyclic procedure; and (3) redundancy requirements in residue codes. A cyclic decoder and other instrumentation for Bose–Chaudhuri–Hocquenghem are also discussed. M.P.G.

N64-33541 International Business Machines Corp., Bethesda, Md. Federal Systems Div.
ERROR CONTROL THROUGH CODING. VOLUME V: ANALYSIS AND COMPARISON OF ERROR CONTROL TECHNIQUES Final Report
R. J. Benice and A. H. Frey, Jr. Griffiss AFB, N.Y., RADC, Jul. 1964 62 p refs
(Contract AF 30(602)-2958)
(RADC-TDR-64-149, Vol. V; AD-607526)

The complete behavior of three different types of retransmission logics is analyzed. This analysis has admitted errors in both the forward and the return channel. Furthermore, the effect of undetectable errors on the system has been considered. The formulas derived are used to choose the best variation of the different types of logics, to compare the various retransmission logics with each other, and to compare the performance of retransmission systems with conventional forward error-correcting codes. Author

N64-33542 International Business Machines Corp., Bethesda, Md. Federal Systems Div.
ERROR CONTROL THROUGH CODING. VOLUME VI: THE DESIGN OF ERROR CONTROL SYSTEMS Final Report
R. J. Benice and A. H. Frey, Jr. Griffiss AFB, N.Y., RADC, Jul. 1964 29 p refs
(Contract AF 30(602)-2958)
(RADC-TDR-64-149, Vol. VI; AD-607527)

This report describes a systematic method for selecting an error-control system that will be nearly optimal for a given application. The application is characterized by the error statistics of the channel and by the user's constraints on the system. The optimization is made with respect to cost. One part of the report is in the format of a handbook for error-control-system design, and in the other section the handbook is explained in detail, with clarification of formulas and procedures and establishment of the validity of the procedures. D.E.W.

N64-33543 International Business Machines Corp., Bethesda, Md. Federal Systems Div.
ERROR CONTROL THROUGH CODING. VOLUME VII: ADAPTIVE ERROR CONTROL SYSTEMS Final Report
F. P. Corr and A. H. Frey, Jr. Griffiss AFB, N.Y., RADC, Jul. 1964 68 p refs
(Contract AF 30(602)-2958)
(RADC-TDR-64-149, Vol. VII; AD-607437)

Principal conclusions drawn from this study are as follows: (1) The design of a system, on a full-duplex link capable of adapting block length, can be achieved at moderate cost. (2) On the hf links tested the gains with this system were meager, and it is anticipated that performance will be better on land lines. (3) For combatting Rayleigh fading, variable block length has more potential than single error correction with fixed block length. It is also stated that, if feasible, variable bit rate offers still more potential for combatting fading in terms of average- and low-percentile efficiency. D.E.W.

N64-33544 International Business Machines Corp., Bethesda, Md. Federal Systems Div.
ERROR CONTROL THROUGH CODING. VOLUME VIII: EXPERIMENTAL VERIFICATION AND OTHER STUDIES Final Report
F. P. Corr and A. H. Frey, Jr. Griffiss AFB, N.Y., RADC, Jul. 1964 35 p
(Contract AF 30(602)-2958)
(RADC-TDR-64-149, Vol. VIII; AD-607438)

The results of three investigations are given: (1) The techniques used in another volume of the series for the gathering of error statistics, for data reduction, for selection of the optimum system and prediction of its performance are verified experimentally. (2) The mathematical development showing the equivalence of block error rates as a function of n and the distribution of error-free intervals are given. (3) A technique for combining error detection with message framing is described. D.E.W.

N64-33547 Ohio State U. Research Foundation, Columbus Antenna Lab.
THE CALCULATION OF RADOME DIFFRACTION PATTERNS
Jack H. Richmond 15 Sep. 1963 33 p refs
(Contract AF 33(616)-7614)
(Rept.-1180-13; AD-423660)

Based on an integral-equation solution, a new technique has been developed for calculating the diffraction pattern of a dielectric radome. To test the method, it was used to calculate the pattern of a horn antenna with a wedge radome; the results show good agreement with experimental measurements. In contrast with ray-optics solutions, this technique accounts accurately for scattering by the radome vertex region, multiple reflections, and surface-wave excitation. Author

N64-33566* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A VERTICAL TEST RANGE FOR ANTENNA RADIATION MEASUREMENTS
John Steckel and William Korvin Jul. 1964 53 p refs
(NASA-TM-X-55094; X-632-64-243) OTS: $3.00 fs; $0.50 mf

Of primary importance was the capability of the test range to adequately absorb and/or suppress undesirable electromagnetic energy as low as 125 Mc, which would normally be reflected from the chamber walls and floor. The satellite antennas of concern are of the broad-pattern, near-omnidirectional type (i.e., dipole, turnstile, etc.). The preliminary study, investigation, and 1/9-scale chamber model measurements indicated that a feasible reflection coefficient level of the order of 20 dB to 25 dB can be expected in an electrically small chamber of approximately $2\lambda \times 2\lambda \times 1\lambda$ in size. Subsequent full-scale measurements in the completed chamber have verified these reflection coefficient levels. At higher frequencies of operation it was

anticipated (and also indicated by 1/9-scale chamber model measurements) that the reflected energy level would be lower. Author

N64-33567* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TELEMETRY ON-LINE MONITORING, COMPRESSION, AND TRANSMISSION SYSTEM FOR THE MANNED SPACE FLIGHT NETWORK (TOMCAT). VOLUME I: SYSTEMS DESCRIPTION
Sep. 1964 24 p
(NASA TM-X-55099; X-546-64-257) OTS: $1.00 fs; $0.50 mf

This report describes the data-handling system for fulfillment of automatic-telemetry summary-generation requirements of the Gemini network, for selection of data to support site flight-control personnel, and for transmission of compressed raw Gemini and Agena data. Telemetry formats are described for Gemini and for Agena, and station equipment is discussed. TOMCAT programs are listed. D.E.W.

N64-33580* Alabama U., University
RADIATION FIELDS OF A LOOP ANTENNA
Thomas D. Shockley, Jr. Repr. from Proc. Inst. Elec. Electron. Engr., v. 52, no. 8, Aug. 1964 1 p refs
(Grant NsG-381)

The near- and far-field equations of a given circular loop antenna are derived by boundary-value techniques. It is assumed that the thin wire, single-turn circular antenna is located in the x-y plane with its center at the origin and that it is excited by a uniform in-phase sinusoidal current. D.E.W.

N64-33590 Columbia U., New York, N.Y. Electronics Research Labs.
ELECTRO-OPTICAL SIGNAL PROCESSING TECHNIQUES FOR PHASED ARRAY ANTENNAS Quarterly Progress Report P-3/119, Apr. 1–Jun. 30, 1964
L. Lambert 1 Jul. 1964 52 p refs
(Contract AF 49(638)-1113; ARPA Order 279)
(CU-40-64-AF-1113-ERL; AD-446283)

The output light distribution of the spatially multiplexed system is an optical analog of the far-field pattern of a linear phased-array antenna; the physical location of light intensity peaks in the output light distribution corresponds to the angular location of all targets contributing to the antenna aperture distribution. The experimental spatially multiplexed system is described. Initial results obtained with this system for simulated input signals corresponding to target locations over a range of $\pm 60°$ are presented. These results indicate that the system output has a nearly ideal beamwidth and sidelobe response. The design considerations of a signal simulator for the time-delay multiplexed system are also presented. Author

N64-33596 RAND Corp., Santa Monica, Calif.
ON DISTRIBUTED COMMUNICATIONS: I. INTRODUCTION TO DISTRIBUTED COMMUNICATIONS NETWORKS
Paul Baran Aug. 1964 42 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3420-PR; AD-444830)

This memorandum briefly reviews the distributed communications network concept and compares it to the hierarchical or more centralized systems. The payoff in terms of survivability for a distributed configuration in the cases of enemy attacks directed against nodes, links, or combinations of nodes and links is demonstrated. The requirements for a future all-digital-data distributed network that provides common user service for a wide range of users having different requirements is considered. The use of a standard format message block permits building relatively simple switching mechanisms using an adaptive store-and-forward routing policy to handle all forms of digital data including "real-time" voice. A comparison is made between "diversity of assignment" and "perfect switching" in distributed networks. Author

N64-33606 California Inst. of Tech., Pasadena Owens Valley Radio Observatory
ACCURATE RIGHT ASCENSIONS FOR 227 RADIO SOURCES
E. B. Fomalont, T. A. Matthews, D. Morris, and J. D. Wyndham 1964 34 p refs
(AD-444164)

Two 90-ft steerable paraboloids were used as an east-west interferometer to measure the right ascension of 227 radio sources. The observations were made between January 1960 and July 1961, at spacings of 195λ (958 Mc/sec) and 283λ (1390 Mc/sec). Corrections for resolution and known confusing sources have been evaluated. The standard errors for a source position range between 3 sec of arc and 20 sec of arc, with an average value of 9 sec of arc. Author

N64-33620* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPLICATION OF EDDY CURRENT CLUTCHES TO TRACKING ANTENNA DRIVE SYSTEMS
Nicholas A. Raumann Jul. 1964 59 p refs
(NASA-TM-X-55084; X-525-64-203) OTS: $3.00 fs; $0.75 mf

A study of the feasibility of an eddy-current clutch-drive application to an 85-ft antenna system is discussed, along with the construction and characteristics of eddy-current clutches. Also discussed is an eddy-current clutch simulator built to evaluate the clutch. The advantages and disadvantages of other types of drives (dc motors, hydraulic, etc.) are pointed out, and the drives are compared with the eddy-current clutch. On the basis of the comparisons it is concluded that the eddy-current clutch drive has one major advantage—reliability and, consequently, decreased maintenance. Disadvantages are: relatively high inertia and, therefore, poor torque-to-inertia ratio; predominant field time constant that limits bandwidth; nonlinear operation, and heat-dissipation problems that cause poor efficiency. P.V.E.

N64-33626* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MANNED SPACE FLIGHT NETWORK PERFORMANCE ANALYSIS FOR THE SA-6 MISSION
O. Womick and N. R. Heller 1 Sep. 1964 46 p
(NASA-TM-X-55104; X-552-64-290) OTS: $2.00 fs; $0.50 mf

This report contains a performance analysis of the Saturn launch vehicle and of the Apollo space system under operational conditions. Emphasis is placed on the compatibility of the Saturn–Apollo configuration during launch and injection into orbit, and the tests of the structural soundness and aerodynamics of the spacecraft. The following studies were made: Network Support Preparations; Acquisition Aid; Telemetry; Radar; Reentry Contingency Tracking; Computing Center; Ground Communications; Network Data Reduction; and Ancillary Support by Other Networks. G.G.

N64-33641 Bendix Corp., Baltimore, Md. Bendix Radio Div.
SATELLITE COMMUNICATIONS TRANSPORTABLE GROUND TERMINAL. VOLUME II: ANTENNA EQUIPMENT Final Report, 9 Dec. 1961–1 Sep. 1963
Sep. 1963 229 p refs
(Contract DA-36-039-SC-87504)
(SYN-52-07-01; AD-444241)

The SYNCOM ground antenna is a 30-ft-diam parabolic reflector with prime focus feed, mounted on a trailer. Two functionally independent feed systems with separate rf transmission lines provide communications: (1) Transmission is accomplished by the shf feed, consisting of a stationary finned circular waveguide horn with polarizer. (2) Reception is provided by a uhf finned circular waveguide feed that surrounds the shf horn. The antenna control system can be operated in one of three modes—manual, remote, or auto acquire—by depressing one of the main mode selector switches. The parametric amplifier provides 40 dB of gain over a 10-M bandcenter around 1817 Mc and has an excess noise temperature of 120° K maximum. Three nondegenerate, one port circulator-coupled stages are used, and the temperature of the diode mounts and circulators is maintained at 125° F. The pump source at 10.46 Gc features controlled environment and a solid-state leveler circuit to minimize gain instability. Author

N64-33644 California Inst. of Tech., Pasadena Owens Valley Radio Observatory

A CATALOG OF LINEAR POLARIZATION CHARACTERISTICS OF RADIO SOURCES IN THE WAVELENGTH RANGE 10 TO 21 CM

D. Morris and G. L. Berge 1964 16 p refs
(Contract Nonr-220(19))
(AD-444165)

A list of linear polarization measurements for 66 radio sources is presented. It includes values for 39 sources not previously reported, and a more complete set of values for the sources previously described. Of these sources, approximately 40 have been examined at three different wavelengths (10, 18, and 21 cm), and for those with appreciable polarization in this range the dependence of polarization on wavelength is given. The relationship between the major axis position angle and the intrinsic polarization angle of double radio sources is discussed. Author

N64-33645 Ohio State U. Research Foundation, Columbus Antenna Lab.

AN ELEMENTARY INTEGRATED DIRECTION-FINDING SYSTEM

John R. Copeland and William J. Robertson 1 Jul. 1964 20 p refs
(Contract AF 33(657)-10386)
(Rept.-1566-12; AD-444523)

A simple, 1000-Mc direction finding or homing system is described. The system operates by simultaneous lobe switching in the horizontal and vertical planes. Lobe-switching is accomplished by an integral design of the video detector, asymmetrical feed, and diode-switched delay line, incorporated into a log-periodic dipole array, the two halves of which are layered, diametrically opposing, onto the inside surface of a transparent glass cone. The switch-drive, amplifiers, and readout display are located in an external control box. Angular coverage of the direction finder is approximately an 80° cone surrounding the nose-on symmetry axis, with some minor irregularities in the off-axis calibration. Causes and cures of the irregularities are discussed. Author

N64-33697 Datametrics Corp., North Hollywood, Calif.

STUDY OF UNPOWERED PERSONAL TRANSMITTER TECHNIQUES Research Contract Status Report No. 1, 1 Nov. 1963–15 Jan. 1964

19 Jan. 1964 10 p refs
(Contract AF 33(615)-1130)
(AD-442888)

The effect to date has been concerned primarily with the various techniques for generating dual carrier bipolar modulated signals. Two basic types of oscillators (transmitters) have been built and tested—the Clapp LC oscillator and the crystal-stabilized Hartley oscillator. Author

N64-33723 Columbia U., New York, N.Y. Electronics Research Labs.

THE THEORY AND PHYSICAL CONSTRAINTS OF AN ELECTRO-OPTICAL SIGNAL PROCESSOR FOR PHASED ARRAY ANTENNAS Technical Report T-1/199

L. Lambert and M. Arm 1 Oct. 1963 49 p refs
(Contract AF 49(638)-1113; ARPA Order 279)
(CU-29-63-AMC-74(R)-ERL; AD-446299)

Techniques are described for processing the signals obtained from the elements of a phased-array antenna by means of electro-optical devices. These techniques employ one electro-optical device that simultaneously forms, as a continuum, all the beam patterns that a receiving planar array antenna is capable of forming. An analysis of an electro-optical processor for phased arrays is presented that shows the following: (1) The target location angles are obtained unambiguously for each and every target that can be resolved. (2) Target angle resolution is identical to the resolution inherent in the antenna array. (3) Multiple targets produce multiple outputs with all angles properly associated. (4) The progressive envelope delay that is introduced at the antenna array does not result in an aperture-bandwidth constraint. Author

N64-33750 Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.

SELF-TUNING ANTENNA Final Progress Report for Fiscal Year 1964

James E. Howell 28 Jul. 1964 97 p
(RG-TR-64-9; AD-446387)

This task involves the development of a self-tuning antenna that will prevent signal "dropout" during reentry or other times of severe environmental conditions that cause detuning of the antenna. The three basic areas of investigation conducted were the logic-type self-tuning antenna, the servo-type self-tuning antenna, and a normalizing circuit that is a basic component of the above two antenna systems. Author

N64-33765 Ohio State U. Research Foundation, Columbus Antenna Lab.

BEAM DISTORTION BY A CONDUCTING CYLINDER IN THE APERTURE OF A GROUND-SEARCH ANTENNA

Richard E. Lawrie 1 Nov. 1963 57 p refs
(Contract AF 33(615)-1081)
(Rept.-1751-1; AD-423581)

A simple method is presented for evaluating by calculation the effect on the shape of the beam of a conducting cylinder in the aperture of a ground-search antenna. Measured patterns are presented that demonstrate this effect and also serve as a check on the accuracy of the method described. Author

N64-33767 Advanced Technology Corp., Timonium, Md.

INVESTIGATION OF IMPROVED AIRBORNE ANTENNA TECHNIQUES FOR COMBAT SURVEILLANCE Final Technical Report

Marvin Cohn and Robert Littlepage 30 Jun. 1964 143 p refs
(Contract DA-36-039-SC-90750)
(AD-445798)

Measurements to determine the launching efficiency of the PM_{11} mode in the partially dielectric loaded parallel plane

trough guide have been performed. Results indicated a launching efficiency of 90% for uniform thickness dielectrics. The functional dependence of the coupling coefficient for a single radiating slot in the trough side wall was determined. Based on this, an array of 20 slots was designed to have the $\sin^2 x/x^2$ radiation pattern. An accurate and economical method for fabricating arrays by chemical milling was used to produce a 594-slot array having a $\csc^2\theta$ radiation pattern. The resulting patterns are given for this array. A method for constructing large aperture arrays based on the use of subarrays, each of which has a uniform amplitude distribution, is described. An analysis has shown that excellent radiation patterns can be achieved in this manner. Author

N64-33772 CBS Labs., Stamford, Conn.
QRC-214 (T) WIDE BAND RECORDER AND SUPPORTING EQUIPMENT Informal Technical Monthly Progress Report No. 11, 16 Feb.–15 Mar. 1964
Frank A. Comerci 31 Mar. 1964 5 p
(Contract AF 33(657)-10468)
(CLD-1600; AD-442889)

Equalization of the reproducing amplifiers of the system was completed. The ground equipment was then integrated and the overall response was examined. Operation with sinusoidal square wave and pulse inputs was approximately equivalent to that of the overall electrical system except for impaired signal-to-noise ratio. The cabinets of the airborne system were subjected to high-temperature, low-temperature, altitude, and explosion conditions with no serious malfunction. Other environmental tests and results are reported. Procedures and a narrative summary of the vibration tests are given. D.E.W.

N64-33790 Dynatronics, Inc., Orlando, Fla.
ULTRA LONG-RANGE TELEMETRY STUDY. VOLUME I Technical Documentary Report, Jun. 1963–Apr. 1964
J. T. Murphy, Jr., A. O. Roche, P. E. Mallory, T. G. Coleman, and M. H. Nichols Wright-Patterson AFB, Ohio, AF Avionics Lab., Apr. 1964 123 p refs
(Contract AF 33(657)-11462)
(AL-TDR-64-87, Vol. I; AD-445705)

Signalling and detection methods are considered that optimize the utilization of the transmitter power. The choice of the communication system model and the model itself are discussed. Detailed attention is given to the modulation method, signal structure, and receiver requirements from the aspect of optimization under a power conservation constraint. Techniques to increase the information rate are considered in the message processing area. Redundancy removal techniques and efficient encoding of the resulting messages are considered as a method of increasing the information rate without an attendant increase in the actual transmitted symbol rate. Optimization of message processing is considered, and methods to make the processing adaptive are studied. Author

N64-33791 Dynatronics, Inc., Orlando, Fla.
ULTRA LONG-RANGE TELEMETRY STUDY, VOLUME II
J. T. Murphy, Jr., A. O. Roche, P. E. Mallory, T. G. Coleman, and M. H. Nichols Wright-Patterson AFB, Ohio, AF Avionics Lab., Apr. 1964 307 p refs
(Contract AF 33(657)-11462)
(AL-TDR-64-87, Vol. II; AD-445706)

Appendixes are presented that discuss the following aspects of the ultra-long-range telemetry study: (1) analog versus discrete systems; (2) finite-alphabet communication systems; (3) transmitted-signal spectrum for finite-alphabet systems; (4) synchronization of phase-modulated systems; (5) channel transmission rates for coherent and incoherent systems; (6) linear estimates of sample values; (7) aspects of a particular class of nonlinear transformations; (8) classes of adaptive prediction systems; and (9) approaches to the buffer problem. P.V.E.

N64-33796 Naval Ordnance Lab., Corona, Calif. Research Dept.
THE USE OF SFERICS AS A SIGNAL SOURCE IN THE MEASUREMENT OF VERY-LOW-FREQUENCY ANTENNA PATTERNS
D. A. Schriner, E. W. Seeley, and C. N. Perle 1 Jul. 1963 55 p refs
(Contract Nonr-3803(00); Proj. Defender)
(NOLC-581; AD-423493)

The equipment designed for the new system is designated a passive pattern plotter (PPP). The circuit includes a direction-of-arrival section, which measures the bearing of the sferics received by a crossed-loop antenna and a comparator section, which indicates the gain of the antenna under test in relation to that of a short monopole antenna. The results are presented on oscilloscope screens, which are photographed by a 35-mm shutterless pulse camera. The photographic data are then reduced and plotted to form the antenna pattern. The information produced by the PPP results in antenna-pattern data with an accuracy of $\pm 1.5°$ in azimuthal values and ± 2 dB in relative-gain values over a dynamic range of ± 30 dB. The PPP has also proved to be a useful tool in adjusting antenna parameters to form superdirective arrays. Author

N64-33848 IIT Research Inst., Chicago, Ill.
ELECTRONIC EQUIPMENT CHARACTERISTICS: RADAR TYPES First Quarterly Progress Report, 15 Feb.–15 May 1964
J. J. Krstansky, I. N. Mindel, R. D. Standley, M. W. Scheldorf, and P. Toulios [1964] 106 p
(Contract DA-28-043-AMC-00004(E))
(Rept.-1; AD-603639)

The objectives of this program are to establish measurement procedures for defining interference characteristics of U.S. Army radar equipments. The areas of investigation include two approximate techniques for determining the mode purity of rectangular waveguide mode launchers, use of mode launchers as receivers, transmitter spectrum signature measurements using a pattern integration technique, advanced measurements techniques for determining the interference characteristics of tracking radars and including a survey of army type radars, and initial investigations concerned with the performance of a measurement program to determine the correlation between in guide and radiated field measurements. Author

N64-33867* Hayes International Corp., Birmingham, Ala. Missile and Space Support Div.
APOLLO LOGISTICS SUPPORT SYSTEM MOLAB STUDIES: TELEMETRY SYSTEMS STUDIES FOR A LUNAR MOBILE LABORATORY
J. M. Patten Huntsville, Ala., NASA. Marshall Space Flight Center, Oct. 1964 125 p
(Contract NAS8-5307)
(NASA-CR-61018) OTS: $4.00 fs; $1.00 mf

This report is intended to survey the telemetry field with emphasis on equipment and techniques applicable to the MOLAB mission. The measurement list is a compilation of estimated measurements for the MOLAB mission. The scientific instrumentation is given in the form of sketches and descriptions pertinent to each experiment. The operation and function of the conventional transducers is described, with illustrative sketches for operation. The properties of signal

conditioners, various configurations, and the advantages of each method are discussed. A study is given for analog- and digital-type tape recorders with numerous charts, tables, and nomographs to assist in the evaluation of data compression techniques. Examples are cited in both methods with full descriptions of their characteristics. Author

N64-33880* Hayes International Corp., Birmingham, Ala. Missile and Space Support Div.
APOLLO LOGISTICS SUPPORT SYSTEMS MOLAB STUDIES. MICROWAVE SYSTEMS STUDIES
R. A. Moore Oct. 1964 88 p refs
(Contract NAS8-5307)
(NASA-CR-61010) OTS: $3.00 fs; $0.75 mf

This study provides some comparison between the optimum antenna gain and the transmitter power, with a low-mass system as the prime objective. The following pertinent studies were made: "Molab RF Communication Problem Areas"; "Malfunction of Electrical or Mechanical Equipment and Its Effect on the Communications Link"; "Molab S-Band Effective Radiated Power Requirement"; "State-Of-The-Art of Various RF Transmitters and Power Amplifiers"; "Molab S-Band System Mass Analysis"; "S-Band Lunar Surface Relay Link"; and "S-Band (Voice) Link." G.G.

N64-33919* Canterbury U., Christchurch (N. Zealand)
A RADAR INVESTIGATION OF METEORS OF SUB-VISUAL MAGNITUDES
Colin S. L. Keay Jun. 1964 26 p refs Submitted for Publication
(Grant NsG-219-6Z)
(NASA-CR-59371) OTS: $2.00 fs; $0.50 mf

The operation of an improved type of radar system for delineating meteor radiants is described. The system is capable of detecting the trails produced by 10th magnitude meteors (corresponding to electron densities as low as 5×10^{11} m^{-1}). High rates of detection, quite often exceeding 1000 meteors per hour, are readily obtainable. At these rates it is found that some of the recognized showers are completely masked by the dense background of faint meteors, whereas other shower streams appear to degenerate into scattered sporadic centers of activity. Author

N64-33994 Burroughs Corp., Paoli, Pa.
RADIO VIDEO DIGITIZER AND AZIMUTH DIGITIZER Final Report
Paul D. Pasquine Apr. 1964 143 p
(Contract FA-WA-4697)
(RD-64-124)

This report covers the design, fabrication, and preliminary acceptance testing of an automatic target data processor comprising one radar video digitizer (RVD) and one azimuth digitizer (AD). The processor, a part of the Advanced Radar Traffic Control System (ARTS), accepts radar video and azimuth synchro voltages from an airport surveillance radar, processes the video, and furnishes a target coordinate message in a format suitable for input to the track-while-scan computer. The equipment is also designed to function with an air route surveillance radar. The RVD uses statistical methods in detecting targets and incorporates an automatic clutter elimination feature that assures a high probability of detecting those targets otherwise obscured by thermal noise or clutter. Targets are detected by an advanced, double-threshold method. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-32721 Microwave Electronics Corp., Palo Alto, Calif.
DEVELOPMENT OF LOW NOISE TRAVELING-WAVE TUBES PHASE III: ENVIRONMENTALIZATION Monthly Status Letter No. 20, 1 Sep.–1 Oct. 1963
A. C. Ashley and W. Raub [1963] 11 p
(Contract NObsr-81227)
(MEC-MTR-NObsr-81227-20; AD-421851)

One S-band tube passed preliminary electrical and environmental tests. An X-band tube that had completed more than 1000 hours of life testing was experimentally vibrated under increasingly severe conditions until destruction. This tube withstood vibrations far beyond specification requirements and gave a good account of itself before a heater weld finally opened. A second X-band tube passed 850 hours on life test without incident. Author

N64-32743 Comitato Nazionale per l'energia Nucleare, Frascati (Italy)
A TRIGGER CIRCUIT FOR SPARK-GAP [UN CIRCUITO DI TRIGGER PER SPARK-GAP]
M. Fascetti and A. Massarotti 25 Jul. 1964 5 p refs In ITALIAN *Its* Nota Interna No. 254
(LNF-64/39)

A spark-gap trigger circuit for the Adone deflector is described. Trans. by P.F.E.

N64-32811 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A NEW COMPREHENSIVE INTEGRAL CRITERION FOR OPTIMALIZATION OF AUTOMATIC CONTROL SYSTEMS
Aurel Avramescu 16 Dec. 1963 16 p refs Transl. into ENGLISH from Rev. Electrotech. Energet., Acad. R.P.R., v. A7, no. 1, 1962 p 155–165
(FTD-TT-63-1107/1+2+4; AD-447404)

An optimization criterion is developed for designing or improving automatic control systems that maintain a constant output. The transfer function is expressed in terms of its zeros and poles, and it is shown that the optimum behavior of the control system depends upon minimizing the values that this function assumes along the negative real axis in the neighborhood of the zero point. In order to obtain nonoscillating and quickly responding control systems, the principal poles must be shifted as far as possible to the left, thereby enlarging their negative real part and increasing the damping of the system. The poles (undamped) lying near the zero point on the negative real axis are compensated by a zero lying as close as possible to it. The shifting of a pole or zero in one direction or the other can immediately be recognized as favorable or unfavorable so that error can be avoided. M.P.G.

N64-32893* Thermo Electron Engineering Corp., Waltham, Mass.
SURFACE AND ADSORBATE STUDIES Second Quarterly Report, 25 Jun.–25 Sep. 1963
[1964] 41 p refs
(Contract NAS3-2539)
(NASA-CR-59008; TE-29-64) OTS: $2.00 fs; $0.50 mf

The effects of the addition of cesium fluoride to the cesium normally used in a vapor converter were observed. A photoelectric scanner with a polycrystalline molybdenum surface was used to determine the effects upon the converter parameters of the halide additions. The data were correlated along Rasor plots, and it was found that the fluoride additive caused the same type of shift as has been observed in converter testing with additives. This parallelism is of importance. The physical properties of a thermionic scanner that uses a single-crystal tungsten emitter are discussed. G.G.

N64-32900 France. Ministere de l'Air, Paris
STUDY AND APPLICATION OF AN ELECTRONIC DEVICE FOR MEASURING VERY WEAK DELAYS BETWEEN TRANSITORY SIGNALS IN THE LOW FREQUENCY BAND [ETUDE ET REALIZATION D'UN DISPOSITIF ELECTRONIQUE MEASURANT DE TRES FAIBLES RETARDS ENTRE DES SIGNAUX TRANSITOIRES DE LA GAMME DES BASSES FREQUENCES]
Paul Bildstein Serv. de Doc. Sci. et Tech. de l'Armament, Jul. 1964 97 p refs In FRENCH *Its* Publ. Sci. et Tech. Notes Techniques No. 139

An apparatus for determining the directions of arrival of very long electromagnetic waves by measuring the delay between signals received by three antennas 500-m apart is studied. A system is derived that consists of input circuits (antennas, preamplifiers, and cables), an analog calculator carrying out elementary operations, an analog divider, and a simple readout system, thus permitting a direct and continuous printout of the direction of arrival. Trans. by M.P.G.

N64-32904 Joint Publications Research Service, Washington, D.C.
SIMPLE METHOD OF TESTING DISCRETE-ACTION ELEMENTS AT HIGH SWITCHING FREQUENCIES
M. S. Neyman and G. P. Zemtsov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 30–48 refs (See N64-32901 24-08) OTS: $6.00

A method for testing amplitude, frequency, phase, and video-pulse discrete-action elements for reliable operation is proposed and described. The method does not call for the use of complicated or specialized apparatus, and is suitable at very high timing frequencies, on the order of tens, hundreds, and thousands of megacycles. Results of an experimental verification of the method are presented for the case when an amplitude flipflop with a tunnel diode, operating at timing frequencies larger than 100 Mc, is tested. Author

N64-32908 Joint Publications Research Service, Washington, D.C.
STABILITY OF THE Q OF A CIRCUIT WITH INDUCTIVE EFFECT, BASED ON pn JUNCTIONS
V. Ye. Prozorovskiy, L. N. Kolesov, and L. L. Afanas'yev *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 81–89 refs (See N64-32901 24-08) OTS: $6.00

The dependence of the Q of inductive and reactive transistors on the voltage under conditions of impact ionization in the collector junction is considered. The cause of instability of the Q of this system is analayzed. It is shown that when a negative resistance is introduced in the circuit to compensate for the losses, the stability of the Q greatly decreases. Consequently, a large increase in Q is undesirable. The inductance of the units under consideration depends little on the collector voltage. If a considerable increase in Q is necessary, special measures must be adapted with respect to stabilization of the supply voltages. Author

N64-32909 Joint Publications Research Service, Washington, D.C.
SYNTHESIS OF BROADBAND VOLTAGE TRANSFORMER
B. A. Chekannikov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 90–104 refs (See N64-32901 24-08) OTS: $6.00

A method of transformer design is proposed. The method includes a procedure for solving the problem of optimal choice of transformation coefficient in the desired frequency band for specified values of the series-connected resistance, R, and the load capacitance, C_o, and for obtaining the structure of the transformer and the values of the individual components contained in it. P.V.E.

N64-32910 Joint Publications Research Service, Washington, D.C.
CONCERNING THE COMPENSATION OF THE FREQUENCY THERMAL COEFFICIENT OF QUARTZ IN TRANSISTOR SELF-OSCILLATOR CIRCUITS
O. T. Sokolov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 105–121 refs (See N64-32901 24-08) OTS: $6.00

The compensation of the frequency thermal coefficient (FTC) of a quartz resonator with the aid of XR networks and the capacitance of a p-n junction of semiconductor devices is considered as applied to transistorized self-oscillators. The conditions for total compensation are calculated. The control-voltage pickups are calculated and compared. Experimental results are given. Author

N64-32911 Joint Publications Research Service, Washington, D.C.
USE OF MATCHING TRANSFORMER TO INCREASE FIGURE OF MERIT OF TRANSISTOR AMPLIFICATION STAGES
Yu. A. Volkov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 122–134 refs (See N64-32901 24-08) OTS: $6.00

Information on the use of matching transformers in transistor amplifier stages is refined and generalized. The effectiveness of utilization of matching transformers is estimated from the point of view of the voltage and current figures of merit of the stage. Expressions are derived for maximal transformation coefficients that insure the maximum figure of merit. Author

N64-32912 Joint Publications Research Service, Washington, D.C.
PARAMETRON WITH FERROMAGNETIC FILMS
V. A. Sokolov and B. Ya. Fel'dman *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 135–147 refs (See N64-32901 24-08) OTS: $6.00

A parametron with ferromagnetic film is considered. Results are presented of a theoretical investigation of the excitation conditions, the stationary mode, and the topology of the Van der Pol plane is qualitatively described for the case of soft excitation. The results of the solution of the equations of the parametron with an analog computer and of an experimental investigation are presented. Author

N64-32913 Joint Publications Research Service, Washington, D.C.
MULTISTAGE CASCODE AMPLIFIER WITH NONLINEAR LOAD
E. A. Mel'nikov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 148–158 refs (See N64-32901 24-08) OTS: $6.00

The gain of an amplifier made up of a series of tubes connected in series is considered. An expression is derived for the gain when a pentode is used as a common load resistance. The question of stabilization of the operating point is considered. Experimental material is presented. Author

N64-32914 Joint Publications Research Service, Washington, D.C.
PRINCIPAL CHARACTERISTICS OF SUMMING DEVICES
L. Ya. Il'nitskiy *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 159–166 refs (See N64-32901 24-08) OTS: $6.00

By a generalized mode-voltage method expressions are obtained that characterize the main properties of summing devices. The formulas obtained, in spite of the need for setting up the admittance matrix for any concrete circuit, simplify the analysis. Examples are presented of the use of the derived relations in the analysis of a summing network with a computing amplifier. Author

N64-32915 Joint Publications Research Service, Washington, D.C.
ESTIMATE OF RELIABILITY OF CERAMIC TUBULAR CAPACITORS
M. M. Nekrasov and A. N. Franchuk *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 167–174 refs (See N64-32901 24-08) OTS: $6.00

The theory of inhomogeneity of the internal field not only explains the causes of capacitor failure, but also predicts their service life. A physical method, which is described, makes it possible to choose capacitors that are absolutely reliable in time intervals that are specified beforehand. The entire complicated system of testing and equipment is replaced by the measurement of only one parameter, $tg\delta$. It is possible to monitor the reliability of capacitors directly during their production, that is, to organize good operative control of their manufacturing technology. Author

N64-32916 Joint Publications Research Service, Washington, D.C.
COMPARATIVE INVESTIGATION OF A VARICAP AND FERROELECTRIC IN THE DECIMETER BAND
N. T. Bova *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 175–178 refs (See N64-32901 24-08) OTS: $6.00

On the basis of measurements, it can be assumed that the parameters of ferroelectric elements of small dimensions, made on the basis of ferroelectric ceramics $Ba(Ti, Zr, Sn)O_3$, are identical to the typical parameters of varicaps. The ferroelectric elements are superior to the varicaps in being able to operate in circuits with high energy level, and in being mechanically more reliable. Author

N64-32917 Joint Publications Research Service, Washington, D.C.
METHOD AND INSTRUMENT FOR THE MEASUREMENTS OF TRANSMITTED POWER AT MICROWAVE FREQUENCIES
V. A. Petrov, L. A. Zubritskiy, A. I. Tereshchenko, and V. Ye. Konovalov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 179–185 refs (See N64-32901 24-08) OTS: $6.00

An electronic electric-field intensity meter of the transmission type was constructed for measuring waves in a waveguide. The operating principle of the instrument is described briefly, and some experimental results are given. Author

N64-32923 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF RECOVERY PROCESSES IN THE CIRCUIT OF A GENERATOR OF A LINEARLY-VARYING VOLTAGE WITH POSITIVE FEEDBACK
O. P. Nazarov *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 211–217 refs (See N64-32901 24-08) OTS: $6.00

In the investigation of a transistorized generator of linearly varying voltage with positive feedback, principal attention is paid to the analysis of the forward travel of the sawtooth voltage. In practical circuits using a large capacitor as the charging voltage source, it becomes necessary to deal, as a rule, with the recovery processes. In this paper the recovery processes are considered without accounting for the duration of the diffusion processes in the semiconductor devices, i.e., for sweeps of relatively large duration (on the order of hundreds of microseconds). Author

N64-32924 Joint Publications Research Service, Washington, D.C.
CALCULATION OF VOLTAGE OF SELF-OSCILLATOR WITH SELF-BIAS DUE TO GRID CURRENT
K. S. Polulyakh *In its* Izv. VUZov: Radio Eng., No. 3, 1964 21 Oct. 1964 p 218–224 refs (See N64-32901 24-08) OTS: $6.00

A method is presented for calculating the voltage of a self-oscillator with self-bias due to grid current, from known circuit parameters. The method is suitable for an overvoltage and undervoltage operation, and can be used for the calculation of the load characteristic of generator transducers, and also for the determination of the voltages of generators operating at constant load. Author

N64-32931 Naval Ammunition Depot, Crane, Ind.
INFORMATION ON MICROELECTRONICS FOR NAVY AVIONICS EQUIPMENT μ-Notes No. 8
J. H. Namaroff (Naval Air Develop. Center), and M. R. Buffington 1 Oct. 1964 156 p Prepared jointly with Naval Air Develop. Center
(QE/C-64-607; AD-449495)

This paper covers the utilization of microelectronics in airborne electronic equipment. The following topics are discussed: "Power Supplies for Microelectronic Equipments"; "Microelectronic Function Device Type MA/AA20-01"; "Evaluation of Signetics Digital Microelectronic Functional Devices"; "Data Link Equipment AN/ASW-25"; "Airborne Digital Computer AN/ASA-27"; "Compilation of Microelectronic Functional Devices Evaluated to Date"; and "Analysis of Remington Rand Univac's Studies of Failure Modes of Microelectronics." G.G.

N64-32936 Los Alamos Scientific Lab., N. Mex.
NET-1 NETWORK ANALYSIS PROGRAM, 7090/94 VERSION
Allan F. Malmberg, Fred L. Cornwell, and Florian N. Hofer 16 Sep. 1964 117 p refs
(Contract W-7405-ENG-36)
(LA-3119) OTS: $2.25

The program simulates the dc steady-state behavior and the transient behavior of a large class of electrical circuits that may contain passive and solid-state components. Operating instructions are discussed under the headings of the preparation of input for the NET program, the interpretation of results, and operating details. Sufficient information is given to enable the designer of an electrical circuit to perform a complete

NET analysis of the circuit. The models, or equivalent circuits, of transistors and diodes in the NET program, and the parameters that control the behavior of the models are discussed. This latter part is to aid in substituting alternate parameter values for those contained in NET's internal library of transistors and diodes. D.E.W.

N64-32974 Illinois U., Urbana Coordinated Science Lab.
A STUDY OF THE PROJECTIONS ON ELECTRODES AND THEIR EFFECT ON ELECTRICAL BREAKDOWN IN VACUUM
Harry E. Tomaschke Jan. 1964 109 p refs
(Contract DA-36-039-AMC-02208(E))
(R-192; AD-429464)

The present investigation was undertaken to investigate the characteristics of projections that exist on electrode surfaces and to determine the correlation between the geometry of the projections and the prebreakdown current–voltage characteristics of the electrodes. Fowler–Nordheim plots of the prebreakdown currents predicted that the projections should be of the order of 10^{-4} to 10^{-5} cm in diameter and have a length about ten times the diameter. Direct observations of electrode profiles with an electron microscope confirmed that projections of the predicted size and shape did exist on the electrode surface. Electrical breakdown resulted in the disappearance of one or more projections and sometimes caused the formation of new projections. Author

N64-32976 Martin Co., Baltimore, Md. RIAS Div.
THE ROLE OF SYSTEM FUNCTIONS IN THE REPRESENTATION AND ANALYSIS OF LINEAR SYSTEMS
Leonard Weiss Mar. 1964 50 p refs
(Contracts DA-36-034-AMC-0221-X; AF 49(638)-1206)
(TR-64-4; AD-443039)

The concept of the system function as an input–output representation of linear differential systems for use on time-varying systems is presented. A general theory behind the system-function concept is developed, and examples are given. Also, system functions as separable functions of their arguments are discussed. G.G.

N64-32987* Case Inst. of Tech., Cleveland, Ohio Digital Systems Lab.
ANALYSIS OF A DIGITAL SERVOSYSTEM EMPLOYING PULSE-FREQUENCY FEEDBACK
Duane A. Beisner 1964 144 p refs
(Grant NsG-36-60)
(NASA-CR-59064; EDC-1-64-22) OTS: $4.00 fs; $0.75 mf

The problem of placing the transducer which measures the controlled variable of a closed-loop automatic control system at a point as close to that controlled variable as possible is discussed. Loop-closure directly at the point of measurement of the controlled variable is investigated, and a digital, logical scheme employing the management of pulse trains is presented. This system continuously monitors the value of the controlled variable or, more particularly, the results of the controlled variable, carries out a continuous digital sampling, and employs these generated data in a closed-loop control system. Methods of extracting quantitative information representing the controlled variable are discussed, and the necessary logical synthesis of the system required to process these data to a form suitable for the control of a prime mover is presented. Author

N64-33003 Microwave Associates, Inc., Burlington, Mass.
HIGH POWER SEMICONDUCTOR PHASE SHIFTING DEVICES Final Progress Report, 1 Jan. 1962–1 May 1964
Joseph F. White May 1964 93 p refs
(Contract NObsr-87291)
(AD-601003) OTS: $3.00

Highest power and lowest insertion loss results were obtained using the transmission mode enhancing its usefulness in phased array radar. This PIN diode phase shifter provided peak power operation at 15 kW at both L- and S-bands with total insertion loss values 0.7 and 0.9 dB, respectively, for 180°, 8 equal increment phase shift characteristics. Peak power operation to 37 kW at S-band and 140 kW at L-band was realized with smaller phase shift values. The transmission reflection circuit mode utilizing PIN diodes for phase control basically yields switchable time delay, and models were constructed that were operated to 48 kW at L-band and 5 kW at S-band. Continuous phase control for low-power applications was demonstrated a L- and S-bands with a figure of merit of approximately 250 degrees phase shift per decible of insertion loss per kilomegacycle of operation using the transmission reflection mode. These used 180 kMc cutoff frequency varactors as phase control elements. Author

N64-33014 International Rectifier Corp., El Segundo, Calif.
HIGH VOLTAGE SILICON RECTIFIER STACKS. PRODUCTION ENGINEERING MEASURE Quarterly Progress Reports No. 9 and 10, 25 Jun.–24 Dec. 1963
Arnold Conn and E. J. Diebold [1964] 63 p
(Contract DA-36-039-SC-85977)
(AD-603501)

The preproduction test report is divided in actuality into two sections—a tabular summary of test results together with a discussion of difficulties encountered, and a tabulation of original test data. Certain difficulties were encountered during testing, due to previously unnoticed voltage transients in the high-voltage life-test apparatus that destroyed two columns. However, upon removal of these transients and rebuilding of the columns, no further difficulties were encountered. Author

N64-33038* MetroPhysics, Inc., Santa Barbara, Calif.
SOLID STATE THERMOSTAT Quarterly Progress Report No. 1
19 Aug. 1964 18 p
(Contract NAS8-11625)
(NASA-CR-58858) OTS: $1.00 fs; $0.50 mf

This is a report of studies of sensing methods that led to the adoption of a scheme where the thermistor sensing element was placed in the feedback path of a dc amplifier. The design approach of packaging, the problems encountered, and the test results are discussed. E.C.

N64-33050 Watkins-Johnson Co., Palo Alto, Calif.
DEVELOPMENT OF A 100 KW L-BAND TWT FOR PHASED ARRAYS Final Report
M. V. Purnell 13 Mar. 1964 86 p
(Contract AF 19(628)-500)
(AD-600312)

A ring-bar circuit that operates at 23 kV was selected for use in this tube. A perveance 5-grid solid electron beam gun was developed for this tube. The tube was focused using a solenoid, PPM, and single reversal permanent magnet configurations. Power outputs in excess of 100 kW were measured. Beam efficiencies in excess of 30% were also measured. The tube was constructed as a grounded cathode tube, which required unique techniques for mounting the circuit, the anode, making connections to the circuit, and the development of an rf match to the circuit. Author

N64-33054 National Aeronautical Lab., Bangalore (India)
TRANSISTORISED MULTIPLEXER
S. Nagabhushana and C. S. Rangan May 1964 14 p refs
(TN-SE-6-64)

A transistorized multiplexer for scanning four analog data inputs, such as from an electrical transducer, has been described. The scanning rate can be varied from 3 msec to 3 sec in five fixed-interval steps. The equipment can handle input signals, amplitude 0 to 1.5 V rms. The maximum noise level is 2 mV. The number of channels can be increased without much difficulty, the limiting factor being the speed at which the scanned analog data can be recorded or digitized, stored, and punched. Being transistorized, the instrument is compact, stable in operation, and consumes very low power. Author

N64-33086 California U., Berkeley Lawrence Radiation Lab.
MAGNETOSTRICTIVE READOUT FOR "WIRE SPARK CHAMBERS"
Victor Perez-Mendez and James M. Pfab 21 Aug. 1964 21 p refs
(Contract W-7405-ENG-48)
(UCRL-11620)

A method for measuring recording spark positions in wire chambers is described. The method couples magnetically the signals from each wire of the chamber to a single readout lead for each chamber plane. This is done by placing a thin nickel ribbon magnetized to a suitable bias level, in close proximity to the chamber wires, so that the magnetic field of the spark current that flows through any wire of the chamber to a common ground lead is coupled to the nickel ribbon. The resulting magnetostrictive deformation travels along the nickel ribbon with the velocity of sound to both ends. Located at one end of the nickel ribbon is a small pickup coil. The arrival of the deformation pulse changes the magnetization in the ribbon element within the pickup coil and thus—by the inverse magnetostrictive or Villari effect—produces a voltage signal a few millivolts in amplitude. The spark position in the chamber is determined by measuring the time interval between the onset of the spark discharge and the output pulse from the pickup coil. P.V.E.

N64-33128 Army Materiel Command, Washington, D.C.
SERVOMECHANISMS. SECTION 4: POWER ELEMENTS AND SYSTEM DESIGN Engineering Design Handbook
P. E. Smith, Jr. et al Aug. 1963 206 p refs
(AMCP-706139)

The significant features of servooutput members are presented, and a discussion is given of the typical procedure that can be used as a guide when designing a servosystem. This is followed by descriptions of two representative servosystems from existing Army equipment. Supplementary design information is given on auxiliaries and construction techniques. D.E.W.

N64-33150 Joint Publications Research Service, Washington, D.C.
AUTOMATION MEASURING DEVICES
21 Oct. 1964 19 p refs Transl. into ENGLISH from Izmeritel'naya Tekhn. (Moscow), no. 6, Jun. 1964 p 7–9, 33–36
(JPRS-27005; TT-64-51261) OTS: $1.00

Two papers are presented on the subjects of selection of measuring devices for automation and mechanization of control and of a "time-interval number" function generator. Conclusions of the first paper include statements that demands of machine building on measuring devices consist of maximally connecting control and technological functions, that the most long-range of the completely automated units are the multigroup sorting devices that contribute directly to the engineering process while fulfilling control functions, and that in an adjusted and stable engineering process, the multimeasuring control devices are the simplest and most precise in measuring, and often are more reliable than those for automatic control. In the second paper, the functions and design of a function generator for numbered time intervals for use in systems of automatic control are discussed. A method is recommended for designing a function generator, and the construction of a transistorized circuit is briefly described. D.E.W.

N64-33170* Tennessee U., Knoxville Control Theory Group
NONLINEAR ADAPTIVE CONTROL SYSTEMS WITH STORAGE Scientific Report No. 4
Naresh K. Sinha 15 Dec. 1963 22 p refs
(Grant NsG-351)
(NASA-CR-58963)

This paper considers adaptive control systems that have nonlinear controllers with storage. Staircase techniques have been used to derive the optimizing equations for calculating the optimum parameters of the compensator for the least mean square error between the actual output and the desired output in terms of the statistical properties of the input signal and the plant dynamics. An example of an input-adaptive system has been calculated showing the superior performance of a power-series controller with storage over the optimum linear controller, as well as the optimum power-series controller without storage. Author

N64-33207* Oklahoma State U., Stillwater School of Electrical Engineering
EXTENDED STUDY OF HIGH CURRENT SWITCHING DEVICES Annual Summary Report, 1 Jul. 1963–30 Jun. 1964
D. D. Lingelbach 1 Jul. 1964 373 p
(Contract NAS8-2552)
(NASA-CR-59002) OTS: $7.00 fs; $2.00 mf

The major subject areas are analysis and performance, contacts, design, vibration, and design theory. Each subject has a brief summary presented at the beginning of that part, along with a table of contents. Author

N64-33213* Lockheed-Georgia Co., Marietta Georgia Nuclear Labs.
FIELD EFFECT TRANSISTORS Components Irradiation Test No. 3
15 Jun. 1964 41 p ref
(Contract NAS8-5332)
(NASA-CR-59200; ER-7360; ND-3013)

Three types of field effect transistors were subjected to a radiation environment at a controlled temperature of 30° ± 2° C. The sample size was 20 specimens of each type. Irradiation was continued until the specimens had accumulated an average integrated flux of 5.0×10^{14} n/cm^2 plus a gamma dose of 5.8×10^6r. During the irradiation, measurements were made to define the g_m and I_{GSS} parameters. Test results indicated that the g_m parameter of the transistors was degraded by the nuclear radiation. The mean g_m of each group had decreased 50% after a total radiation exposure. A slight correlation was noted between low values of initial g_m and early failure. The I_{GSS} parameter of the FE 200 and 2N2844 types was increased by nuclear radiation. The I_{GSS} of the 2N2841 type remained below instrument range throughout the test. Author

N64-33290* Stanford Research Inst., Menlo Park, Calif.
FLUX SWITCHING IN MULTIPATH CORES Final Report

D. Nitzan and V. W. Hesterman Jun. 1964 181 p refs *Its* Rept.-3 Prepared for JPL
(Contracts NASw-6; JPL-950095)
(NASA-CR-59245) OTS: $5.00 fs; $1.25 mf

The parabolic inelastic switching model $\phi = \phi_p(F)\eta(\phi)$, where $\phi_p(F)$ is the peak ϕ of a step-F switching, is improved by replacing the parabola $\eta = 1 - (\phi/\phi_s)^2$ by the parabola $\eta = 1 - [(2\phi + \phi_s - \phi_d)/(\phi_s + \phi_d)]^2$, in which ϕ_d is the ϕ value on the static $\phi(F)$ curve. Additional models are proposed for the initial elastic and inelastic ϕ spikes of step-F switching. Using extended ALGOL-60 language, a computer procedure was written for computing $\phi(F,\phi)$ from the improved inelastic switching model. Computer ALGOL-60 programs, which use the $\phi(F,\phi)$ procedure, were written for the numerical solutions of several magnetic-circuit problems. Author

N64-33306 General Electric Co., Schenectady, N.Y. Advanced Technology Lab.
ULTRA HIGH POWER TRANSMISSION LINE TECHNIQUES Fourth Quarterly Progress Report, 1 Jan.–31 Mar. 1964
John P. Quine Griffiss AFB, N.Y., RADC, Aug. 1964 39 p refs
(Contract AF 30(602)-2990)
(RADC-TDR-64-277; AD-607042)

The purpose of this investigation is to develop systematic procedures for selecting optimum waveguide configurations and for designing waveguide components that will operate at high levels of peak and average power in the frequency range 1 to 10 Gc. Further analysis and calculations are presented for tapers and directional couplers for oversized rectangular waveguide. Author

N64-33320 Weizmann Inst. of Science, Rehovoth (Israel)
APPARATUS FOR THE PRODUCTION OF INTENSE TRANSIENT MAGNETIC FIELDS
G. Menczel (M.S. Thesis) 1 Jun. 1964 35 p refs
(Contract AF 61(052)-654)
(TN-S; AD-602640)

The paper describes the design of a pulsed field unit to obtain fields up to 200 kG inside a volume of about 5 cm^3. The coils are wire wound and are connected directly to a 2000μF capacitor bank by means of a triggered spark gap. The discharge in almost all the coils is oscillatory with a half period of the order of m secs. Discharge characteristics, forces acting on the coils, and temperature rise during discharge are discussed. Arrangement of the capacitors in the bank, spark gap, and reinforcement of coils are described. Electrical designs, safety features, and measurement instructions are given briefly. Author

N64-33340* California U., Berkeley Electronics Research Lab.
ANALOG CIRCUITS FOR ENERGY AND FUEL OPTIMAL CONTROL OF LINEAR DISCRETE SYSTEMS
M. D. Canon and E. Polak [1964] 24 p refs
(Grant NsG-354)
(NASA-CR-59248) OTS: $1.00 fs; $0.50 mf

The purpose of this paper is to explore the possibility of using analog networks for solving minimum fuel and minimum energy problems for linear discrete systems. The necessary theorems for circuits consisting of nonlinear resistors, current and voltage sources, and transformers are developed. Physical components are substantially accounted for, and a method of implementation for simple systems is indicated. Author

N64-33361 Naval Ordnance Lab., White Oak, Md.
PERFORMANCE ANALYSIS OF AN AC ELECTRIC ARC POWER SUPPLY
Richard L. Humphrey Oct. 1964 40 p
(NOLTR-63-275; AD-448455)

The performance of the power supply of the 3 MW research arc is predicted by an analysis that represents the arc voltage as a square wave in a series circuit consisting of a voltage source, a limiting reactor, resistance of the substation, and the arc voltage. First an analysis is made assuming that only a limiting reactor is in the arc circuit. Then an analysis with both reactance and resistance present is performed. The results are in good agreement with experimental data from the arc. Author

N64-33415 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
A SUMMARY OF CURRENT RESEARCH AT THE MICROWAVE RESEARCH INSTITUTE Progress Report No. 25, 1 Oct. 1963–31 Mar. 1964
Ernst Weber [1964] 159 p refs
(Grant AF-AFOSR-453-63)
(R-452.25-64; AD-601855)

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N64-33438 National Aeronautical Lab., Bangalore (India)
A HIGH INTENSITY SPARK LIGHT SOURCE FOR SCHLIEREN AND DIRECT SHADOW PHOTOGRAPHY
S. Srinath Kumar, L. S. Manavalan, and C. S. Rangan May 1964 21 p refs
(TN-SE-5-64)

A high-intensity light source of short duration that can be used for schlieren and direct shadow photography is described. The source is essentially a high-voltage spark that can be synchronized with the event under study or triggered with a preset delay. Provision is also made in the head assembly for changeover to a continuous light source (tungsten filament lamp) for schlieren studies, the optical alignment remaining the same. Author

N64-33445 Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group
PHASED ARRAY STUDY Interim Development Report, 1 Jul.–1 Oct. 1963
1 Oct. 1963 35 p refs
(Contract NObsr-89427)
(FR-63-14-231; AD-422210)

Circuit analysis of the phase bit has been conducted to obtain design criteria for high-power, low-loss bits that will operate over at least a 10% frequency band. Analysis has been made for the forward mode, reverse mode, and diode on a stub. The results show the requirements for high junction capacitance and low diode resistance (both forward and reverse). The impedance level of operation should be low. Author

N64-33504 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE THEORY OF RANDOM PROCESSES AND ITS APPLICATION IN RADIO ENGINEERING, PART II
B. R. Levin [1957] 211 p refs Transl. into ENGLISH from "Teoriya Sluchaynykh Protsessov i Ee Primeneniye v Radiotekhnike" Moscow, Izd. Sovetskoye Radio, 1957 496 p
(F-TS-9811/V; AD-602224) OTS: $6.00

Subjects covered in this second part of the two-volume work include nonlinear transformations of the normal random process, statistical characteristics of the envelope and phase of a normal random process, passage of normal random process through standard radio-equipment sections, power spectra of signals modulated by random processes, and elements of information theory. D.E.W.

N64-33520 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EVALUATION OF DIFFERENTIAL AMPLIFIER CIRCUITS IN ELECTROPHYSIOLOGICAL RESEARCH
D. N. Menitskiy 23 Mar. 1964 9 p refs Transl. into ENGLISH from Elektron. v Med. (Moscow), 1960 p 143–148
(FTD-TT-63-1196/1+2+4; AD-600124)

In evaluating the quality of differential amplifiers, there has been great divergence in the numerical quantities obtained because different parameters are used in the definition of discrimination, rejection, or symmetry coefficients. Also the number of cascades for which these coefficients are calculated is significant. Results of this study show the following: (1) For quality characteristics of the individual differential stages, it is useful to examine two quantities—the rejection coefficient that represents the relation of the amplification of the cascades and the symmetry coefficient that shows the degree to which the paired tubes are matched in a symmetrical cascade. (2) The quality of a multicascade differential amplifier can be characterized by the noise suppression coefficient. (3) Considering their use in clinical physiological experiments and diagnoses, large coefficients of noise suppression can be realized only by additional balancing of the voltages at the input of the amplifiers. D.S.G.

N64-33521 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE THEORY OF FUNCTIONAL GENERATORS OPERATING ON A CATHODE RAY TUBE
O. I. Petrenko 19 Aug. 1964 31 p refs Transl. into ENGLISH from Avtomatyka (Kiev), no. 2, 1962, p 26–41
(FTD-TT-64-379/1+2; AD-606493)

The transformation of a graphic image of an analytically or experimentally obtained function of a certain variable into the form of an electric lead for further utilization is discussed. A functional transformer–photoformer, using the beam of a cathode ray tube with a bandpass of several kilocycles and an accuracy of 1% to 2%, is calculated. The mode of operation is discussed, and the basic static equations of the system are formulated. G.G.

N64-33545 Bendix Corp., Southfield, Mich. Research Labs.
INVESTIGATION OF TECHNIQUES FOR SPACE-ORIENTED TUBES Final Report
John G. Meeker and A. G. Peifer Griffiss AFB, N. Y., RADC, Sep. 1964 160 p refs
(Contract AF 30(602)-2984)
(RADC-TDR-64-201; AD-607529)

The expected space environment, both natural and artificial, has been carefully catalogued, and a special treatment for calculating the ionizing radiation of the Van Allen Belts was developed, including assumptions and their degree of uncertainty. The effects of the overall environment of the materials of a space-tube package were evaluated, and the materials were given a preference ranking. The essential properties required of a space tube are also enumerated, and means of achieving them discussed, in detail, for linear-beam tubes, especially for traveling-wave amplifiers required to operate in the range between 1 Gc at 10 000 W cw and 10 Gc at 100 W cw. Limitations and problem areas are pointed out, and some new concepts have been advanced. Author

N64-33546 Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
FAILURE MECHANISMS IN MICROELECTRONICS Final Report
Griffiss AFB, N.Y., RADC, Aug. 1964 95 p refs
(Contract AF 30(602)-3017)
(RADC-TDR-64-252; AD-607426)

Investigations were performed on three types of microelectronic devices—multiple diode wafers, inversion layer diode amplifiers, and versatile linear amplifiers. Two failure mechanisms were identified and studied in detail—unsuspected diffusion barriers from photoetch procedures, and variations in passivation layer properties. The relationship to these, of current amplification (beta), or reverse voltage breakdown, of leakage, and other quantities was examined. Each step in microelectronic device fabrication was investigated for its contribution to failure mechanisms. A partially conducting region in the passivating oxide was identified and studied, 300 ±100 Å from the silicon. This contributes to the leakage in microelectronic devices usually attributed entirely to channels in the silicon. Author

N64-33548 Eitel-McCullough, Inc., San Carlos, Calif. High Power Microwave Tube Lab.
HIGH POWER X-BAND GENERATOR Quarterly Report No. 7, 1 Apr.–30 Jun. 1964
William R. Luebke, Jared Leidigh, and Tore Wesselberg 18 Sep. 1964 41 p
(Contract AF 30(602)-2756)
(RADC-TDR-64-451; AD-607261)

The purpose of this program is to develop a klystron amplifier operating at 8 kMc and delivering 1 MW of CW power. A long pulse tube was tested to 60 kW of average power at which point catastrophic window failure occurred. A second long-pulse tube with a new window design was operated successfully for several hours at more than 200 kW average and 500 kW peak power output. A short pulse tube using extended-interaction input and penultimate cavities was built. Test results are presented. Author

N64-33559* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WIDE DYNAMIC RANGE PULSE HEIGHT ANALYZER WITH DATA COMPRESSION, COINCIDENCE LOGIC, AND DIGITAL READOUT CIRCUITS
S. Paull, C. Cancro, and R. Mc Gowan 15 Jun. 1964 57 p
(NASA-TM-X-55077; X-611-64-183) OTS: $3.00 fs; $0.50 mf

The Mark 6 Coincident Pulse A. to D. Converter and Readout System (ADCR-6) is a three-parameter pulse height analyzer employing amplitude range selection to give 6400 levels with coincidence logic and tape recorder readout circuits. The system is designed for nuclear abundance E vs dE/dx measurements on high-altitude balloon flights. Three photomultiplier tubes in a scintillation telescope furnish signal pulses to the pulse height analyzer inputs identified as Channel A, Channel B, and Channel C. Pulse height analyzer operation is controlled by the coincidence logic circuits so that input pulse amplitude information on all three channels is fed to a 16-track tape recorder in digital form whenever simultaneous inputs occur on Channels A and B. Author

N64-33571 Admiral Corp., Chicago, Ill. Government Electronics
EFFECTS OF NUCLEAR RADIATION ON FREQUENCY CONTROL DEVICES Seventh Quarterly Report, 1 Mar.–31 May 1964
Bernard Gerstein, Albert Fueyo, and Frank Trainor 30 Jun. 1964 58 p
(Contract DA-36-039-AMC-00002(E))
(G3988-Q7; AD-445254)

This report deals substantially with the effects encountered when subjecting a variety of frequency control devices to a pulsed nuclear environment. Forty-six CR-19/U crystal units with construction variations, eight single-sideband crystal units, and one temperature-compensated oscillator (TCXO) were exposed under dynamic conditions. Phase and amplitude change were recorded for all units. In addition, frequency was also recorded for the single-sideband crystal units and the temperature-compensated oscillator. To investigate the theory of gamma flux dependence, half the sampling was enclosed in a moderator-converter (flux converter) to obtain an enhancement of the reactor gamma flux. Transient phase changes recorded in the study of CR-19/U variations bear a definite relationship to the construction constituents. Author

N64-33642 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
ADVANCED FABRICATION PROCESSES FOR FUNCTIONAL ELECTRONIC BLOCKS Interim Engineering Report, 2 Mar.–2 Jun. 1964
W. T. Matzen 15 Jul. 1964 102 p refs
(Contract AF 33(615)-1242)
(IER-03-64-38; AD-602761) OTS: $1.00

Studies of the silicon adaptive element have been continued. Devices with sputtered oxide films have been fabricated that exhibit photo and thermal adaption properties. Techniques for using this device in an adaptive logic system have been investigated. Experimental studies of the temperature-stabilized substrate are essentially complete so that design of the substrate can be finalized. Several thermal-feedback video amplifiers have been fabricated with evaporated lead patterns. A digital filter was fabricated and operated as the IF stage of a transistor radio receiver. Author

N64-33659 Datametrics Corp., North Hollywood, Calif.
STUDY OF UNPOWERED PERSONAL TRANSMITTER TECHNIQUES Research Status Report No. 6, 1 May–1 Jun. 1964
10 Jun. 1964 23 p
(Contract AF 33(615)-1130)
(AD-447809)

This report contains a study of the crystal stabilized Hartley oscillator circuit and a summarization of the analytic work for this basic oscillator circuit. Two ultrahigh-speed switching transistors were employed with a constraint peak voltage of about 500 millivolts. Oscillation commenced at about a 40-millivolt base-emitter threshold level. Data on the transmitter bandwidth given as a function of transmitter efficiency and oscillator loop gain were evolved by equations, and an improvement in the transmitter stability was formulated. G.G.

N64-33691 Honeywell, Hopkins, Minn. Ordnance Div.
LOW INPUT VOLTAGE CONVERSION First Quarterly Progress Report, 1 Mar.–31 May 1964
John T. Lingle and Kenneth J. Jenson [1964] 52 p
(Contract DA-28-043-AMC-00030(E))
(Rept.-1; AD-450093)

The majority of the work involved the study of the converter circuitry previously developed, emphasizing the reduction of converter weight with no cost in efficiency. In order to achieve weight reduction in affected components, an investigation examined the feasibility of operating the converter power oscillator at 900 cps and the pulse width modulator regulator at 3 kps. Also included was an analysis of factors limiting efficient operation at these higher operating frequencies. Following this study, laboratory tests were conducted to determine if circuit modification (indicated to be advantageous) resulted in the alleviation of limiting factors and the realization of weight reduction at maintained efficiency. A 25 W, 6.5-V-dc regulated exploratory converter model was successfully operated with increased power-oscillator and pulse-width-modulator regulator frequencies with efficiencies of about 70%, and voltage regulation maintained to 6.5 V-dc ±10%. This model was also operated with a battery charging and a dc motor load. Author

N64-33702 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROCEEEDINGS OF INTERNATIONAL SYMPOSIUM ON THEORY OF RELAY SYSTEMS AND FINITE AUTOMATA
10 Apr. 1964 639 p refs Transl. into ENGLISH from Natsional'nyy Kom. Sov. Soyuza po Avtomat. Upravleniyu. Mezhdunarodnaya Federatsiya po Avtomat. Upravleniyu (USSR), v. 24, 1962
(FTD-MT-63-257; AD-605609)

Papers presented at a symposium on relay systems and finite automata in the technology of automatic control of discrete control systems are presented, together with a transcript of the discussion following some of the papers. The symposium covered the following topics: abstract theory of automata; probability automata, reliability, and coding; methods of syntheses of relay networks; minimization of Boolean functions and synthesis of bridging networks; and problems of mechanization in the synthesis of bridging networks. M.P.G.

N64-33706 United Aircraft Corp., Norwalk, Conn. Norden Div.
2-WATT MICROELECTRONIC SERVO AMPLIFIER Final Report
L. Caprio and E. Tatom 15 Jun. 1964 66 p
(Contract NOw-61-1053-c)
(Rept.-1111-R-0010; AD-445099)

This report covers the work accomplished in designing and developing a microelectronic solid-state 2-W servo amplifier. Efforts were directed toward producing a device capable of operating at voltage gains of 200 or 500 with a maximum output voltage 36 ±2 V rms and a minimum power output of 2 W. An electrical circuit having the desired characteristics and which is capable of manufacture as a solid-state device was designed. This circuit is a three-stage dc coupled differential amplifier with two major feedback loops. A 3/8 X 3/8 in., 12-lead studded flat package was developed for the assembly of the amplifier. Each of the delivered amplifiers was contained in one of these packages. The amplifiers were produced through a series of photolithographic and diffusion processes. Device characteristics and technical data are included in this report. Author

N64-33711 Illinois U., Urbana Coordinated Science Lab.
REALIZATION OF THE A-MATRIX OF HALF-DEGENERATE RLC NETWORKS
Ahmet Dervisoglu Jul. 1964 61 p refs
(Contract DA-28-043-AMC-00073(E))
(R-225; AD-603686)

The necessary and sufficient conditions for a matrix to be realizable as the A-matrix of an RLC network are developed. The RLC network is assumed to be nondegenerate or half-degenerate and is assumed to have a connected resistive part. It is shown that if there exists a realization then the given matrix A can be factored into two matrices: one a diagonal matrix of positive entries and the other a symmetric–skew-symmetric (hybrid) matrix. The former determines directly the values of capacitances and inductances in the network. A technique is given by which the terminal matrix of the resistive part and the fundamental circuit matrix of the reactive part can be obtained from the other factor. It is shown that the given matrix A has a realization with a half-degenerate or nondegenerate RLC network which has a connected resistive part if and only if the factorization exists and both the terminal matrix and the circuit matrix are realizable. Author

N64-33726 Illinois U., Urbana Coordinated Science Lab.
NONLINEAR NETWORK ANALYSIS—THE PARAMETRIC APPROACH
L. O. Chua and R. A. Rohrer Jul. 1964 193 p refs
(Contract DA-28-043-AMC-00073(E))
(R-224; AD-604039)

This work presents a unified theory of nonlinear RLC networks using an entirely new approach—the parametric approach. The class of networks considered includes any arbitrary time-invariant, nonlinear RLC network whose elements can be characterized by a unicursal curve. In particular, curves that are multiple-valued functions of both terminal variables, such as the hysteresis curves, are admissible. Through the use of Stieltjes integrals, a generalization of the concepts of "content" and "co-content" as well as of "energy" and "co-energy" is made, which leads directly to a generalization of the Legendre transformation. It is then shown that the equilibrium equations of such networks can always be formulated mathematically as a system of algebraic–differential equations. The Schauder fixed point theorem and the principle of contraction mapping are then used to formulate a number of existence theorems on the solutions of nonlinear resistive networks. Author

N64-33735 Bendix Corp., Ann Arbor, Mich. Systems Div.
STUDY TO DETERMINE EFFECTS OF FISSION PRODUCT GAMMA RADIATION ON ELECTRONIC PARTS AND EQUIPMENT Final Progress Report, 16 May–31 Aug. 1963

Aug. 1963 120 p
(Contract NObsr-87267)
(BSC-39655; AD-423286)

Seven transistor circuits have been analyzed to determine the possible effects of fission-product gamma radiation and temperature on these circuits. The fission-product radiation consists of gamma-ray dose rates up to 3×10^5 rad/hr and total exposure of 1.5×10^4 rad. The temperatures of interest range from 0° to 50° C. Author

N64-33822 ITT Corp., Easton, Pa. Electron Tube Div.
100-KILOVOLT CERAMIC-METAL THYRATRON Second Quarterly Progress Report, 15 Oct. 1963–14 Jan. 1964
G. H. Dixon [1964] 20 p
(Contract DA-36-039-AMC-03272(E))
(Rept.-2; AD-446519)

An internal seal capacitive dividing tube is described that employed a thick gradient grid design. Further evaluation of this thick grid and associated stacking ceramic envelope sections were directed toward the external seal design tube, which is intended for oil immersion operation. Tests of the thick gradient grid are described whereby a single gradient grid was built into a glass tube and a two-gradient-grid ceramic tube was fabricated and operated. Also of external seal design, the following devices in process are described: (1) a three-gradient-grid design for oil operation; and (2) a long creep path stacked envelope design for air operation. Author

N64-33836 Geotechnical Corp., Garland, Tex.
LOW-LEVEL, LOW-FREQUENCY PHOTOCELL AMPLIFIER, PROJECT VT/072
James E. Keele 28 Jul. 1964 101 p
(Contract AF 33(657)-9967; ARPA Order 104-60)
(TR-64-71; AD-446573)

This report describes the development of a low-level, low-frequency photocell amplifier (PCA) having either analog, broadband FM carrier, of IRIG FM carrier output. A galvanometer with a high natural frequency is used in the input circuit for increased ruggedness. Signal frequencies up to 100 cps may be amplified. The amplifier is capable of detecting a signal of 1.25×10^{-18} W in the bandpass from 0.01 to 5 cps. Power requirement is less than 1.7 W. Signal common-mode rejection is greater than 140 dB, and the noise introduced by power-supply variations is negligible. The voltage gain of the PCA with analog output is 350 000. The PCA using broadband FM output in combination with the FM discriminator provides the unique combination of high voltage gain (1×10^6) and high dynamic range (69 dB). "Floating" input, output, and power-supply connections are features of the amplifier. Author

N64-33837 Geotechnical Corp., Garland, Tex.
LOW-LEVEL, LOW FREQUENCY, SOLID-STATE AMPLIFIER
James E. Keele 30 Jul. 1964 47 p
(Contract AF 33(657)-9967; ARPA Order 104-60)
(TR-64-73; AD-446574)

This report describes the development of a low-level, low-frequency, all-solid-state amplifier having either analog, broadband FM or IRIG FM output. The amplifier was developed for amplification of seismic signals in geographic areas where the low-noise detection capability of a phototube amplifier is not required. The equivalent-input noise level for a passband of 0.1 to 5 cps is 1×10^{-6} V. This is equal to 2×10^{-16} W in the 5-kohm input resistor. Signal common-mode rejection is 86 dB, and the effects of power-supply variation are negligible. Power requirements are less than 1 W. Operating temperature is from −60° to +60° C. By using a special filter, the amplifier is capable of operation over a passband of 0.01 cps to 40 kc. Using analog output, the amplifier has a voltage gain of 1×10^4 and a dynamic range of 57 dB. Using broadband FM carrier output, it has a modulation sensitivity of 465 cps/mV and a dynamic range greater than 60 dB. Author

N64-33857 Comitato Nazionale Per l'Energia Nucleare, Frascati (Italy)
TWO CIRCUIT MODULES OF A 100 MEGAPULSES/SEC UNIT, FOR NUCLEAR EXPERIMENTATION
M. Coli, G. Mazza, and A. Villalba 18 May 1964 12 p refs
Its Nota Interna 241
(LNF-64/17)

The functional elements that belong to an automatic pulse-selection and registration unit with dead time less than 10 nsec, particularly suited for nuclear physics experiments with high flux of particles from accelerating machines are described. These are (1) fast coincidence circuitry with anticoincidence, resolving time less than 2 nsec; and (2) current linear gate, linearity better than 1% for pulses from 1 mA to 20 mA amplitude. Author

N64-33882 Aerospace Corp., El Segundo, Calif. Laboratory Operations
ELECTRONICS RESEARCH PROGRAM: INVESTIGATION OF MILLIMETER-WAVE MODULATION AND SIGNAL PROCESSING TECHNIQUES Semiannual Technical Report, 1 Jul.–31 Dec. 1963
L. A. Hoffman, H. J. Wintroub, and C. J. Carter 28 May 1964 71 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-52; TDR-269(4250-45)-2; AD-446429)

The purpose of this investigation is to advance the technology and to determine the feasibility of millimeter-wave systems in the region between 10 mm (30 Gc) and 1 mm (300 Gc). Initial effort centers on two problem areas: low-noise receiver front-ends and stable millimeter-wavelength reference sources. A parametric amplifier approach to low-noise receiver design is being studied, as is the use of a phase-locked klystron system as a stable reference source. Design and fabrication status of the klystron system is presented. Author

N64-33915 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
THE ANALYSIS AND DESIGN OF NONLINEAR CONTROL SYSTEMS VIA LIAPUNOV'S DIRECT METHOD Technical Documentary Report, Oct. 1962–Oct. 1963
Gunther R. Geiss Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1964 306 p refs
(Contract AF 33(657)-9185)
(RTD-TDR-63-4076; AD-607602)

This report presents the theory of Liapunov's direct method and demonstrates its application in the analysis and design of linear control systems. It also presents a review of appropriate elements of matrix theory, matrix differential equation theory, and stability theory with reference to control system problems. The theory of the direct method is developed via simple geometric and functional concepts. The various methods of developing Liapunov functions are reviewed, and applications are given in the stability analysis of nonlinear regulator systems and in the determination of the properties of their transient behavior. The report also reviews the various techniques for designing systems via the direct method and presents examples of nonlinear and adaptive system designs. Author

N64-33959 Joint Publications Research Service, Washington, D.C.
TRANSISTORIZED FREQUENCY STANDARD
Stefan Hahn et al 27 Oct. 1964 14 p refs Transl. into ENGLISH from Przegl. Telekomunikacyjny (Warsaw), v. 36, no. 6, Jun. 1964 p 161–165
(JPRS-27110; TT-64-51366) OTS: $1.00

The design and operating principles of a transistorized quartz-crystal frequency standard for 200 kc/sec and of a system of frequency dividers and multipliers are described. Operating principles, circuit diagrams, and construction details are given for the frequency generator circuit, for the thermostat, for power supply circuits, and for the system of frequency multipliers and dividers. D.E.W.

N64-33965 Illinois U., Urbana Coordinated Science Lab.
THE SENSITIVITY OF GENERAL MULTIVARIABLE FEEDBACK SYSTEMS
J. B. Cruz, Jr. and W. R. Perkins Aug. 1964 14 p refs
(Contracts DA-28-043-AMC-00073(E); AF 49(638)-1383) (R-227; AD-604096)

The new approach for treating the parameter variation problem for a class of multivariable systems is extended to a general feedback configuration for multivariable systems. The general linear, multivariable, feedback system can be represented by two plant transfer-function matrices and three controller transfer-function matrices. A formula for the sensitivity matrix of the general structure is derived. Also, sufficient conditions are obtained for assuring a feedback design that is less affected by parameter variations than another feedback design with the same overall transfer matrix. Author

N64-33977 Lincoln Lab., Mass. Inst. of Tech., Lexington
HIGH-POWER TUBE PROGRAM Final Report
R. C. Butman 30 Nov. 1963 34 p refs
(Contract AF 19(628)-500; ARPA Order 85; Proj. Defender) (ESD-TDR-63-568; AD-425185)

These investigations involved electron physics, materials, thermionic emission, vacuum techniques, and beam-circuit interactions. An investigation was initiated only when it appeared that the possibility of removing a power output limitation existed, or when the limits to power output, as established by some physical phenomenon, required more careful definition. Much of the work has application to any high-power device. In those cases where the program is device-oriented, there is a definite tendency to favor the klystron. This orientation shows that the klystron is the most generally useful radar power amplifier in existence. Author

N64-33985 Microwave Associates, Inc., Burlington, Mass.
LONG LIFE K-BAND DUPLEXER Final Technical Report, 1 Jul. 1962–30 Apr. 1964
R. Brunton [1964] 107 p refs
(Contract DA-36-039-SC-90834)
(Rept.-7; AD-448101)

Efforts were directed toward the development of a long-life K-band duplexer exhibiting extremely low leakage power characteristics. Two experimental duplexer assemblies were delivered as a result of this work. The results of the experimental efforts on this program are presented, and include research and development work in the semiconductor, ferrite, and gaseous switching-device technology. In each area of investigation both theoretical and experimental data are given. The final test results and life test data are given for the two experimental duplexer assemblies, as well as instruction for installation of the duplexer. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-32786 Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
Jun. 1964 48 p refs
(AD-602948) OTS: $1.25

CONTENTS:

1. IDENTITY OF THE CORROSION PRODUCTS OF SOME METALS IN SALT WATER A. J. Pollard p 1–2
2. SOME METHODS FOR WORLD-WIDE ATMOSPHERIC RADIO DUCT MEASUREMENT AND PREDICTION D. L. Randall p 3–16 refs (See N64-32787 24-21)
3. SCIENTIFIC PROGRAM: PROBLEM NOTES p 17–46

N64-32802 McGill U., Montreal (Canada) Mechanical Engineering Research Labs.
THE INSTRUMENTATION AND CALIBRATION OF THE McGILL HYPERSONIC SHOCK TUNNEL
T. K. Morton Aug. 1964 74 p refs
(Grant DRBG-9550-06)
(Rept.-64-5)

The loading system by which the driver gases are metered into the combustion chamber is described, as well as the electrical system used to ignite the mixture. A description of the ionization gages used to measure incident shock velocity, along with the piezoelectric pressure transducers for measuring pressure behind the incident and reflected shocks in the tube, and of the stagnation pressure in the test section is also given. The high pressure resulting from the combustion of a stoichiometric mixture of oxygen and hydrogen, diluted with 76% or 80% helium, is used to break a steel diaphragm and compress the test gas by a reflected shock process. Combustion tests produced peak pressures approximately 25% below those predicted by constant volume combustion theory. Author

N64-32838* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
TWO-DIMENSIONAL FLUX AND CRITICALITY CALCULATIONS FOR THE PLUM BROOK REACTOR
John H. Lynch Washington, NASA, Oct. 1964 49 p refs (NASA-TN-D-2210) OTS: $1.25

A model has been developed to calculate reactor physics effects in the Plum Brook Reactor core, reflector, and test facilities. Results include calculated neutron fluxes in two dimensions and four energy groups and reactivity of the core with rods in, rods out, and at the cold clean measured critical height. The calculated power distributions agree with measured values; the calculated reactivities agree with measurements to within 2.0% reactivity ($\Delta K/K$) at all rod positions. The prompt neutron lifetime and effective delayed neutron fraction were calculated, using the two-dimensional model, to be 57 μsec and 0.00766, respectively. Author

N64-32886* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
LUNAR STORAGE OF SMALL QUANTITIES OF CRYOGENIC FLUIDS

J. R. Olivier and W. M. Mc Combs 21 Jan. 1964 92 p refs
(NASA-TM-X-51918; TR-4-42-2-D) OTS: $3.00 fs; $0.75 mf

This report presents the results of a study of the feasibility of storing small quantities of cryogenic fluids on the lunar surface. Factors taken into consideration were types of fluids, quantity, boiloff, heat-leak, storage time, vented and nonvented concepts, system weight, tank design, and insulation type and thickness. Author

N64-32898 European Atomic Energy Community, Brussels (Belgium)
EURATOM 1964. DOCUMENTATION ATTACHED TO SEVENTH GENERAL REPORT ON THE ACTIVITIES OF THE COMMUNITY (MARCH 1963–FEBRUARY 1964)
Mar. 1964 210 p refs EURATOM: 150 Belg. Fr.

This paper contains a variety of topics pertaining to power reactors, reactor cooling, thermonuclear reactions, nuclear measurements, cost-price evaluation of nuclear electricity, and data processing. G.G.

N64-32942 Electronic Systems Div., Bedford, Mass. Decision Sciences Lab.
AN AUTOMATED FACILITY FOR FORCED-CHOICE SIGNAL DETECTION EXPERIMENTATION
William H. Watkins, Raymond S. Nickerson, and John R. Schjelderup Apr. 1964 22 p refs
(ESD-TDR-64-383; AD-602617) OTS: $1.00

The facility allows presentation of visual, auditory, or bisensory signals for the study of forced-choice signal detection. Means are provided for informing the observer, prior to each trial, of the signal mode he should expect on that trial. Considerable flexibility is provided for the scheduling of intermittent noise (aud. and/or vis.) within an observation interval. The facility includes an observer's station within an anechoic chamber and a control unit in a separate room. Data collection sessions are fully automated. The control system reads a paper tape input and produces a paper tape output. Input (stimulus scheduling) tapes are generated, and output (data) tapes are processed, by a PDP-1 computer. Author

N64-32968 System Development Corp., Santa Monica, Calif.
A GENERAL-PURPOSE TIME-SHARING SYSTEM
Jules I. Schwartz, Edward G. Coffman, and Clark Weissman 29 Apr. 1964 32 p refs Presented at the Spring Joint Computer Conf., Washington, D.C., 21–23 Apr. 1964 Sponsored by ARPA
(SP-1499; AD-443753)

This paper is divided into four major discussions: (1) an outline of the capabilities provided for the user by the equipment and program system; (2) a description of the system's operation, with an analysis of the system scheduling techniques and properties; (3) a somewhat detailed description of two of the currently operating system service programs; and (4) experience and problems. Author

N64-32969 Stanford U., Calif.
DEVELOPMENT OF A TRACER-SPARK TECHNIQUE FOR THE STUDY OF HYPERVELOCITY FLOW FIELDS Technical Report No. 2
James B. Kyser May 1964 38 p refs
(Contract Nonr-225(65); Proj. Defender)
(SUDAER-190; AD-443562)

A technique has been developed for the mapping of velocity fields, with particular application to testing in a spark-heated hypersonic tunnel. Data are obtained in the form of photographs of sparks struck through the flow field under study. Instrumentation to initiate the sparks in the flow has been designed and fabricated, and its performance has been studied analytically and experimentally. Velocity profiles have been obtained in the empty test section with a high degree of success. Attempts to measure velocity profiles in wakes have not been as successful, however. Author

N64-32992* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37–28, VOLUME IV FOR THE PERIOD JUNE 1, 1964 TO JULY 31, 1964. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Aug. 1964 251 p refs
(Contract NAS7-100)
(NASA-CR-58944; JPL-SPS-37-28, Vol. IV) OTS: $6.00 fs; $1.25 mf

This report on supporting research and development pertains to the following: "Systems Division"—systems analysis; "Guidance and Control Division"—flight computers and sequencers, spacecraft electrical power, and guidance and control research; "Engineering Mechanics Division"—materials and applied mechanics; "Engineering Facilities Division"—aerodynamic facilities; "Propulsion Division"—solid-propellant engineering, polymer research, propulsion research, liquid propulsion, and advanced propulsion engineering; "Space Sciences Division"—lunar and planetary instruments, space instruments, space instrument systems, chemistry, fluid physics, and physics; "Telecommunications Division"—communications elements research, spacecraft telemetry and command, and communications systems research. G.G.

N64-33072* National Aeronautics and Space Administration, Washington, D.C.
ADDRESS BY DR. GEORGE E. MUELLER, ASSOCIATE ADMINISTRATOR FOR MANNED SPACE FLIGHT, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, AT THE DEDICATION OF THE MAGIC MOUNTAIN LABORATORY OF THE MARQUARDT CORPORATION, VAN NUYS, CALIFORNIA, OCTOBER 30, 1964 News Release
George E. Mueller 30 Oct. 1964 10 p Available from the Scientific and Technical Information Division

Dr. George E. Mueller states that a landing on the moon is not the paramount objective of the National Space Program, but rather it is to make the Unites States first in space by the development of the total capability in order to compete in the race for space. The manned space flight program contains the four major elements of this goal—the people, the industrial base, the space vehicles and the means to fly them, and the ability to manage a huge research and development activity. G.G.

N64-33077* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NASCOM REAL-TIME SYSTEM
Dale L. Sollars Aug. 1964 28 p refs
(NASA-TM-X-55071; X-571-64-259) OTS: $2.00 fs; $0.50 mf

A modernization program for the communications network used to funnel radar and telemetry data to Goddard Space Flight Center and Cape Kennedy computers was initiated in order to provide the highest degree of automation, to minimize the use of expensive long-haul high-speed circuits, and to give the network a real-time communication capability. The

GSFC was the first switching center to undergo the modernization process. A Univac-490 Real-Time Switching System was chosen for the main switching function and installed. A description is given of the system as it is in present operation. D.S.G.

N64-33089 Joint Publications Research Service, Washington, D.C.
A NEW ASPIRATORY APPARATUS FOR TAKING SAMPLES OF ATMOSPHERIC AIR
L. F. Kachor 30 Oct. 1964 9 p Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 9, Sep. 1964 p 53–57
(JPRS-27169; TT-64-51425) OTS: $1.00

A description is given of an electric aspirator for taking samples of atmospheric air, in order to define its harmful gaseous ingredients. This is a stationary device that takes air samples automatically by a time relay. G.G.

N64-33098* General Electric Co., Cincinnati, Ohio Advanced Engine Technology Dept.
BROMINE TRIFLUORIDE METHOD FOR OXYGEN IN LIQUID ALKALI METALS First Quarterly Report, Jan. 1–Mar. 31, 1964
Hyman Kirtchik, Thomas Lajcik, and Sigmond Culp 20 Apr. 1964 28 p refs
(Contract NASw-882)
(NASA-CR-58942; DM-64-118) OTS: $2.00 fs; $0.50 mf

Previously it was shown that the reaction of bromine trifluoride and potassium could lead to a specific method for oxygen. This requires a quantitative demonstration with superior equipment under more refined operating conditions. The whole system has been designed with much originality, and the major portion has been constructed and assembled. It consists of a helium purification section, a modified NASA extruder, a 10^{-6} torr vacuum system, a BrF_3 purification and reaction system, and a spectrophotometric oxygen measuring section. Calibration, leak checking, and further initial tests are in progress. Author

N64-33113 ARO, Inc., Arnold Air Force Station, Tenn.
AN EXPERIMENTAL STUDY OF SPACE CHAMBER MOLECULAR KINETICS
C. E. Cheeseman and W. F. Mc Rae Arnold Eng. Develop. Center, Oct. 1964 43 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-186; AD-449737)

A discussion of molecular kinetics in space and in space-simulation chambers is given. Results of an experimental investigation of space-chamber-flux profiles are compared to a computer study based on probability theory. As a result of the experimental evidence of the importance of flux levels upon simulation evaluation, a proposal is made that space-chamber performance be defined in terms of flux altitude rather than of pressure. Author

N64-33172* Aerojet-General Corp., Azusa, Calif.
RESEARCH ON PROCESSES FOR UTILIZATION OF LUNAR RESOURCES
S. D. Rosenberg, G. A. Guter, F. E. Miller, and G. R. Jameson Dec. 1963 71 p refs *Its* Rept.-2757 (Summary)
(Contract NAS7-225)
(NASA-CR-58956) OTS: $3.00 fs; $0.75 mf

Laboratory apparatus for studying the catalytic reduction of carbon monoxide with hydrogen was designed, fabricated, and operated. Three different nickel-containing catalysts were evaluated. In addition, a determination was made of the effects on catalyst activity of several impurities in the reactant gas, and of the feasibility of achieving the reduction reaction without catalyst. Virtually quantitative reduction of carbon monoxide with hydrogen was obtained using a catalyst under these conditions; H_2/CO mole ratio, 3:1; space velocity, 1000 hr^{-1}; catalyst bed temperature, 250° C; and catalyst bed pressure, 6.1 atm. Author

N64-33203* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE ALPHA SYSTEM. PHASE I OF A PLAN TO AUTOMATE THE OPERATION OF THE REDSTONE SCIENTIFIC INFORMATION CENTER
Jan. 1964 96 p
(NASA-TM-X-54765; R-Comp-A-64-1) OTS: $3.00 fs; $0.75 mf

Among the items discussed in this report are the organization of the study project, project goals, design criteria, and the ALPHA I system concept and operating information. The system is then described in more detail, and a plan for implementation is presented. Author

N64-33216* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CAPTIVE DYNAMIC-STABILITY TESTS OF THE GEMINI ABORT-SEAT CONFIGURATION IN THE JPL 20-INCH SUPERSONIC WIND TUNNEL
John J. Minich 15 May 1964 9 p refs
(Contract NAS7-100)
(NASA-CR-59057; JPL-WT-20-583) OTS: $1.00 fs; $0.50 mf

The approximate aerodynamic parameters for the test were Mach 1.33, 1.65, 2.21, and 2.81. The test variables and ranges were initial angles-of-attack from 0° to 340°. The model configuration included the seat and two passengers. After moments of inertia and bearing-damping coefficients were obtained, the models were tested by releasing them at various initial angles-of-attack and tunnel flow conditions, and simultaneously taking high-speed motion pictures of the models' motions. R.L.K.

N64-33225* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
AN INTRODUCTION TO ADVANCED ELECTRONIC CONCEPTS IN LAUNCH OPERATIONS
R. B. Wright 31 Aug. 1964 44 p refs
(NASA-TM-X-54747; TR-82-D) OTS: $2.00 fs; $0.50 mf

This report presents several concepts utilizing advanced electronic techniques and devices that would reduce the number of hard-wire umbilical connections to a space vehicle during prelaunch, ground-launch, and orbital-launch operations. Included is a discussion of advanced devices applicable to present and future implementations of the concepts. The major emphasis has been placed on the implementation of light beams as information carriers to replace hard wire presently being used as the interconnecting medium. Author

N64-33263* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
A MULTIUSER COMPUTATION FACILITY FOR EDUCATION AND RESEARCH
Jack B. Dennis Repr. from Commun. Assoc. Computing Mach., v. 7, no. 9, Sep. 1964 p 521–529 refs Previously announced as N64-29176 21-20
(Grants NsG-496; NSF G-16526; Contract Nonr-4102(01))

Implementation is described for a small-scale multiuser computer system that permits several users to work independently with the machine, and to obtain satisfactory response, using typewriter communication. The central processor is able

to shift attention among independent tasks from many users, with one program protected from the actions of another. A large auxiliary memory—a program file—holds all programs with one placed in core memory and run for short time intervals when called up by a user from his console. One field can be read into the core memory while the data formerly there are simultaneously written in a second field. This swap takes place in just 33 msec for a complete field of information. R.L.K.

N64-33327* General Electric Co., Philadelphia, Pa. Space Sciences Lab.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF AN MGD POWER GENERATION DUCT Second Quarterly Progress Report, 11 Oct. 1963–11 Jan. 1964
20 Jan. 1964 19 p
(Contract NAS3-4103)
(NASA-CR-59276) OTS: $1.00 fs; $0.50 mf

This paper pertains to the nonequilibrium techniques using metastables, high-pressure glow discharge, and electron-beam ionization, to develop sustained power generation in an MGD generator with power densities on the order of 10 MW/M^3. The following progress was made: A cathode was operated up to 50 keV in argon, nitrogen, and helium between 2 and 35 mA. The various drawings associated with the electron beam are discussed in detail. Two new test sections to be used to eliminate the cesium attack on the aluminum insulator were designed and tested. Five intermediate temperature experiments were conducted. The design of an airtight exhaust system was completed. G.G.

N64-33349 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
AERODYNAMIC BLAST SIMULATION IN HYPERSONIC TUNNELS
H. Mirels and J. F. Mullen 20 Sep. 1964 29 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-175; TDR-269(4230-10)-10; AD-449689)

The flow behind a blast wave, propagating in the downstream direction in a hypersonic tunnel, is investigated analytically. It is assumed that the tunnel area downstream of the throat has a power-law variation with streamwise distance (i.e., $A \sim r^{\sigma}$) and that the shock is strong. Under these conditions, the self-similar solutions of Sedov and of Hayes and Probstein, for blast-wave propagation in a stationary atmosphere with a power-law density variation, are directly applicable. For a constant-energy blast wave, the shock propagates according to the power law $R \sim t^{2/3}$, where R is the streamwise shock ordinate and t is time. The exponent 2/3 is independent of σ. Expressions are given that define the ideal energy required to generate a strong blast of specified strength in a given hypersonic tunnel. Author

N64-33355 ARO, Inc., Arnold Air Force Station, Tenn.
RADIATION CHARACTERISTICS OF A HIGH POWER LEVEL CARBON ARC
Richard M. Warner and F. Nelms Arnold Eng. Develop. Center, Oct. 1964 39 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-202; AD-450216)

The radiation characteristics of a carbon arc operated at power levels ranging from 35 to 100 kW were determined for solar simulator application. Three types of measurements were made—the spatial distribution of radiation intensity about the source, the brightness distribution within the arc, and the source spectrum. Radiometric intensity values of 175, 250, and 270 $mw\text{-}cm^{-2}$ were measured at a distance of 6 ft from the anode crater at 50-, 75-, and 100-kW power levels, respectively. The region of highest emittance within the arc was centrally located, well defined, and remained stationary. Spectral irradiance measurements with narrow bandpass filters indicated that the carbon arc spectrum closely approximates the Johnson solar curve with excess energy in the ultraviolet and infrared regions but with some deficiency in the visible range. Author

N64-33381* Consultants and Designers, Inc., Arlington, Va.
ADVANCES IN PLANETARY RADAR LOCATION [USPEKHI PLANETNOY RADIOLOKATSII] Review Paper
V. A. Kotel'nikov et al 19 Oct. 1964 22 p Transl. into ENGLISH of a paper from Priroda (Moscow), no. 9, 1964 p 2-14
(Contract NAS5-3760)
(NASA-TT-F-8973; ST-RA-LPS-10222) OTS: $1.00 fs; $0.50 mf

The development of radar techniques for investigation of extraterrestrial bodies is outlined. The application of radar techniques to the following is also discussed: measurement of the distance to planets; determination of the astronomical unit; precisely determining the orbital parameters and dimensions of Venus; investigations of the Venusian surface; and determining the rotation period of Venus. P.V.E.

N64-33482 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
A HISTORY OF THE CENTRIFUGE IN AEROSPACE MEDICINE
William J. White [1964] 94 p

This book contains five chapters as follows: (1) "1795-1930 Observed Phenomena"; (2) "1930–1940 The Stamp of Research"; (3) "1940–1950 A Rising Spiral"; (4) "1950-1960 Centripetal Acceleration Plus"; and (5) "1960—Plans for Tomorrow." E.C.

N64-33487 Canadian Armament Research and Development Establishment, Valcartier
ON THE DESIGN OF A MINIMUM WEIGHT SABOT FOR THE BALLISTIC LAUNCHING OF SPHERES
P. N. Brooks Aug. 1964 51 p refs
(CARDE-TR-490/64)

The relationship between the wall weight and the total weight for an aeroballistic model in a standard bipetal cup-sabot is studied in detail. Two designs for a sphere-sabot are suggested and analyzed, and experimental results are presented for the more promising design. Author

N64-33488 Canadian Armament Research and Development Establishment, Valcartier
CONE LAUNCHING TECHNIQUES AT C.A.R.D.E.
F. Motomura Jul. 1964 17 p refs
(ARPA Order 133)
(CARDE-TN-1604/64)

This note deals with some of the experiments carried out to launch aerodynamically stable cones at velocities of 13 500 fps–14 500 fps. This was achieved in a 20-mm light-gas gun at the range pressures in excess of 40 mm of Hg. The design concepts for the projectiles and the launch techniques used are presented, together with graphs that show the effect of range pressure on the stability of the cones. Efforts made to trace and analyze the source of destabilization, both by theoretical and experimental methods, are also discussed in detail. Author

N64-33525 Melpar, Inc., Falls Church, Va.
SIMULATION OF HELICOPTER AND V/STOL AIRCRAFT. VOLUME III, PART II: COMPUTATIONAL METHODS DIGITAL
Burton G. Tregub, Merlin P. Coffee, and C. E. Russell Aug. 1963 119 p refs
(Contract N61339-1205)
(NAVTRADEVCEN-1205-3; AD-607738)

This report demonstrates the methods of mechanizing the equations of motion of helicopters and V/STOL aircraft by digital computing equipment. The report is based on the mechanization of the final equations developed in Volumes I and II of this report, and assumes a knowledge of them. A general treatment of mathematical methods of analysis and of digital computer techniques is presented. The mathematical models developed in Volumes I and II for helicopters, both single and tandem rotor, and for V/STOL aircraft are presented in a digitally applicable form. Recommendations are given for computer memory size and for computer sophistication based on the findings of the study reported herein. Author

N64-33568* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACECRAFT OPERATIONS MANUAL FOR EPE-D LAUNCH
H. Meyerson 7 Oct. 1964 40 p
(NASA-TM-X-55103; X-672-64-285) OTS: $2.00 fs; $0.50 mf

The manual is to serve as an overall informational guide to all personnel engaged in the launch operations of the EPE-D spacecraft. The following are presented: schedule of events, blockhouse–spacecraft connection diagram, EPE-D communications diagram, EPE-D launch-operations requirements, F-1 countdown, F-O countdown, and spacecraft-malfunction procedure. P.V.E.

N64-33605* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
QUARTZ GLASS PRESSURE VESSELS FOR HYDROTHERMAL STUDIES
R. Speed and A. Filice 15 Aug. 1964 Repr. from Am. Mineralogist, v. 49, 1964 p 1114–1119 refs
(Contract NAS7-100)
(JPL-TR-32-649)

The quartz glass tubes in the system plagioclase-NaCl-Na_2CO_3-H_2O used in hydrothermal studies are discussed. The tubes are prepared as follows. The lower half or charge chamber is made by nesting three close-fitting quartz glass tubes of 1.25-mm wall thickness and appropriate internal diameters and fusing the tubes together in a vacuum. The base of the chamber is sealed, and a thick-walled capillary is fused onto the other end. After loading, the tubes are sealed below the top of the capillary with a hydrogen flame. The quantity of liquid inserted can be controlled to about 0.01 cc/cc with a pipette or syringe. The mass of liquid added can be found by weighing to an accuracy of 0.0005 g/cc. The volume increase of the chamber by thermal expansion from 0° to 500° C is about 0.1%. Coupled with a temperature error of 3° C, these errors produce an uncertainty in a perfect gas pressure of about 1.3%. P.V.E.

N64-33619* Space-General Corp., El Monte, Calif.
IN-TOWER LAUNCH DYNAMICS ANALYSIS Final Report
R. J. Bartholomew, H. B. Amey, and M. A. Kaplan [1964] 183 p refs
(Contract NAS5-3313)
(NASA-CR-60021; SGC-379TD-1) OTS: $5.00 fs; $1.25 mf

A theoretical digital computer analysis of the dynamics associated with the launching of a flexible rocket vehicle constrained to follow a given launch-tower rail distortion pattern is presented. The launch vehicle is represented by a number of its elastic lateral vibration modes; whereas the launch rails are represented as quasi-static flexibilities at the riding shoe attachments, where such flexibilities are periodic but variable with vehicle in-tower position during launch. The launch dynamic loads are computed for a number of digital computer, entire in-tower, simulations of the Aerobee 350 launch from the Wallops Island Launch Tower and are expressed in terms of tower-induced forces normal to rail riding surface, vehicle shear distribution as a function of time, and vehicle bending-moment distribution as a function of time. Aerobee 150A vehicle launch simulations were performed and are compared with flight-test data, as well as with the Aerobee 350 design configuration, together with static margin of safety calculations. These comparisons are used to arrive at an engineering estimate of the degree of loads–stress conservatism inherent in the analysis. Author

N64-33639 Stevens Inst. of Tech., Hoboken, N.J.
EXPERIMENTAL INVESTIGATION OF CUSPED CONTAINMENT GEOMETRIES: CHALICE Annual Report, 1963–1964
George J. Yevick et al [1964] 169 p refs
(Contract AT(30-1)-2582)
(SIT-P126)

Construction of a chalice main bank plasma containment apparatus is progressing. High-frequency corona problems have been encountered in the construction of very-low-inductance, high-voltage transmission lines. A collector plate has been substituted for the collector box in the original design. The bank is also being built in quarters, instead of halves, to permit a wider variety of experiments. All major electronics components are completed, and the overall bank performance is predicted. Although fuses will not be necessary in the quarter-bank design, results of a fuse protection study for the half-bank design are included. Theoretical studies reported include a technique for finding the two-body correlation functions (ion–ion, electron–electron, ion–electron) for a plasma, and an analysis of vertex corrections in plasmas. M.P.G.

N64-33647 School of Aerospace Medicine, Brooks AFB, Tex.
A SURVEY OF PROTON EXPOSURE FACILITIES
Milford D. Harris, Jr. et al Jun. 1964 10 p refs
(SAM-TDR-64-16; AD-443784)

A series of primate whole-body experiments in support of the space radiation program is planned. Proton facilities in the United States and Europe were surveyed for the purpose of selecting sources of protons for use in these studies. A 1-in. × 6-in. proton beam with an average whole-body surface dose rate of 15 rad/min can be duplicated at all facilities visited. However, laboratory space for use by visiting organizations is limited, and cyclotron time must be approved far in advance by the scheduling committee at each facility. Author

N64-33684* Consolidated Systems Corp., Monrovia, Calif.
A DEAD WEIGHT PRESSURE BALANCE WITH EXTENDED RANGE TO 5000 PSIG Final Summary Report
H. Norville 26 Jun. 1964 33 p
(Contract NAS8-5232)
(NASA-CR-59232; CSC-3-0726) OTS: $2.00 fs; $0.50 mf

This report covers the modification of a deadweight pressure balance system (Schuler Balance) by the addition of a

back-pressure regulator and a three-way valve, in order to achieve an extended range of 5000 psig. The system test results and performance values are discussed. G.G.

N64-33721 Naval Ordnance Test Station, China Lake, Calif. Engineering Dept.
ROCKET LAUNCHER STUDIES
D. Rossin, P. R. Zagala, V. J. Taylor, and M. Amparano Aug. 1964 31 p
(NAVWEPS-8501; NOTS-TP-3477; AD-445710)

This report contains the results of tests conducted on the Aero 1A, Aero 6A-1, LAU-32/A, Aero 7D, LAU-10/A, LAU-33A/35A, and NOTS Model 101A (experimental) rocket launchers to determine the forces transmitted to and internal pressures built up in the launchers by the rockets during launching. The structural integrity of two proposed locking devices for the LAU-33A/35A launcher was also evaluated. Author

N64-33731 Lowell Technological Inst. Research Foundation, Mass.
INSTALLATION OF FACILITIES TO BE USED IN CONJUNCTION WITH A SHOCK TUBE Final Report, 17 Apr. 1961–30 Apr. 1964
Kenneth L. Rogers Apr. 1964 18 p
(Contract AF 19(604)-8481)
(AFCRL-64-657; AD-445896)

This report describes the design, construction, and installation of a shock tube facility. The design and construction of a photographic process area is also described. Details of a wave-speed camera and its auxiliary equipment are shown. Author

N64-33734 McGill U., Montreal (Canada)
THE EFFECTS OF WIND TUNNEL SCREENS AND HONEYCOMBS ON THE SPANWISE VARIATION OF SKIN FRICTION IN "TWO-DIMENSIONAL" TURBULENT BOUNDARY LAYERS
R. P. Patel Oct. 1964 34 p refs
(DRB-G-9551-12)
(TN-64-7)

Evidence has been published that the 2 to 2 1/2 q screens that are often used to reduce both spatial and time variations in wind tunnels, themselves introduce small angular deviations in the flow, strongly affecting the growth of a boundary layer downstream. Such screens have been shown to produce unacceptably large variations of skin friction across what would otherwise be a two-dimensional boundary layer. Tests have recently been made in two wind tunnels, and in general these substantiate the published findings for turbulent boundary layers. The spanwise variations are mainly caused by the last screen if its open area ratio is less than about one-half and are nearly independent of the directions of flow through the screen. The accumulation of dust on the screen also has an effect and usually increases the variation. Author

N64-33744 Atomics International, Canoga Park, Calif.
SUPERCONDUCTING NUCLEAR PARTICLE DETECTOR First Trimonthly Report, Mar. 25–Jun. 25, 1964
D. E. Spiel [1964] 30 p refs
(Contract DA-18-035-AMC-107(A))
(A1-64-159; AD-603666)

The activity in this period has been devoted mainly to the design, construction, procurement, and testing of the equipment necessary to the task performance. Several films, however, were manufactured, characterized, and subjected to alpha bombardment. During this irradiation, both propagating and, more significantly, nonpropagating pulses were observed. The amplitudes of these self-recovering pulses varied from ~100μV to ~300μV nearly an order of magnitude larger than calculated. The pulse widths at half maximum were 20 nsec, the limit of the equipment. Critical current vs temperature data for several films are consistent with the results reported by others. Author

N64-33748 Los Alamos Scientific Lab., N. Mex.
THE DEVELOPMENT OF A DRY INERT ATMOSPHERE DRYBOX SYSTEM
Al Zerwekh, William H. Ashley, and Charles F. Metz 5 Oct. 1964 36 p refs
(Contract W-7405-ENG-36)
(LA-3109) OTS: $1.00

This system maintains a working atmosphere of argon containing less than 20 ppm each of oxygen and water. There is no provision for the removal of nitrogen or other residual components of air, with the exception of carbon dioxide. It is instrumented with an oxygen trace analyzer and a portable electrolytic hygrometer. The system consists of three stainless steel dryboxes, each isolated from the balance of the system by "absolute" submicron filters. Each box is fitted with butyl rubber gloves and specially designed neoprene glove port covers for maximum protection against water and oxygen diffusion into the system. Entrance to either end of the system, or communication between individual boxes, is effected through cylindrical airlocks and ports. Author

N64-33776* General Electric Co., Philadelphia, Pa. Missile and Space Div.
HYPERVELOCITY STUDIES IN SIMULATED PLANETARY ATMOSPHERES Monthly Progress Report, 25 Dec.–25 Jan. 1963
J. S. Gruszczynski 25 Jan. 1963 7 p
(Contract JPL-950297)
(NASA-CR-56390) OTS: $1.00 fs; $0.50 mf

The shock tube performance for the 3% CO_2 mixture for four initial driven-tube pressures and the response of the cavity gage to a parallel beam of light were computed. Several test runs in a new six-inch diameter hypervelocity shock tube, with varied gas compositions, are reported. D.E.W.

N64-33852 California U., Livermore Lawrence Radiation Lab.
HAZARDS CONTROL Quarterly Report No. 17, Apr.–Jun. 1964
C. T. Schmidt [1964] 44 p refs
(Contract W-7405-ENG-48)
(UCRL-12004) OTS: $1.00

A whole-body counter (WBC) facility is being planned for the Hazards Control Department. Fluctuations in background radiation levels from laboratory programs make it desirable to locate the WBC facility underground. Earth shielding presents its own source of radioactivity, so there remains the problem of shielding the WBC from the radiation in the soil. Calculations, experiments, and consultations were made to determine the best method for solving this problem, and are discussed. Author

N64-33860 Naval Ordnance Lab., White Oak, Md.
ANALOG COMPUTERS FOR THE EVALUATION OF AERODYNAMIC COEFFICIENTS Aerodynamics Research Report 225
Joseph W. Willis Aug. 1964 20 p refs
(NOLTR-64-74; AD-445097)

During static-stability tests in wind tunnels, it is desirable to have the six aerodynamic coefficients computed on-line

This report describes the special-purpose analog computers designed to make these computations and to display the results. Author

N64-33866 General Electric Co., King of Prussia, Pa. Missile and Space Div.
A DESIGN CRITERION FOR LUNAR PROPELLANT MANUFACTURE Technical Information Series
Dandridge M. Cole and Ronald Segal 8 May 1964 49 p refs
(Rept.-64SD237)

The value of lunar propellants is determined as a function of production efficiency for a typical manned Mars mission and for lunar logistics missions. It is shown that chemical rockets refueled in lunar orbit are competitive (assuming reasonable propellant production efficiencies) with direct Earth–Mars nuclear rockets in terms of initial mass in earth orbit. Author

N64-33876* Hayes International Corp., Birmingham, Ala. Apollo Logistics Support Group
APOLLO LOGISTICS SUPPORT SYSTEMS MOLAB STUDIES: CREW STATION CONCEPTUAL STUDY OF LOCOMOTION PANEL DISPLAY PARAMETERS AND DIGIT CONTROL FOR A LUNAR MOBILE LABORATORY
Alan D. Mc Nair Oct. 1964 47 p refs
(Contract NAS8-5307)
(NASA-CR-61016) OTS: $2.00 fs; $0.50 mf

Results of a parametric analysis of Apollo Logistics Supply Systems–Lunar Mobile Laboratory (MOLAB) are presented. The MOLAB locomotion mechanisms and techniques are functionally described, visual displays and hand- and foot-control requirements are established, and human-engineering requirements and crew tasks are considered. The location, size, shape, type, and dimensions of switches, dials, and knobs on these controls are included. M.P.G.

N64-33909 Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.
MODEL FLY PROGRAM. PART I: THEORETICAL INVESTIGATIONS AND PRELIMINARY DESIGN CONSIDERATIONS Technical Documentary Report, 1 Sep. 1962–31 Aug. 1963
J. A. Hill, X. A. Gikas, A. G. Fonda, and A. J. Gargani Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jul. 1964 79 p refs
(Contract AF 33(616)-8260)
(FDL-TDR-64-49, Pt. 1; AD-607037)

The Model Fly program objective is to develop a wind-tunnel testing technique for simulating the effects of aeroelasticity on the structural loads and stability and control response of full-scale vehicles. A dynamic mounting system is to be developed that allows scaled elastic models to perform free-flight maneuvers in the wind tunnel. The Model Fly development encompasses six technical areas: similitude theory, model construction, mounting system, control theory, instrumentation, and data processing. The problems in each area are discussed, and possible methods of solution are outlined. The present status of the development is summarized. Author

N64-33916 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
SYMPOSIUM ON PROBLEMS IN IRRADIATION CAPSULE EXPERIMENTS, HELD AT GERMANTOWN, MARYLAND, OCTOBER 8, 9, AND 10, 1963
William L. R. Rice, ed. Mar. 1964 631 p refs
(TID-7697) OTS: $6.50

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N64-33932 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.

EPITAXIAL CONTROL SYSTEM Final Report

Don M. Jackson, Jr. 14 May 1964 47 p refs

(Contract AF 19(604)-8351)

(AFCRL-64-582; AD-607060)

The epitaxial vapor analysis system consists of two main sections — the analyzer console, which is built about a small, 90° sector, highly sensitive mass spectrometer, and the gas-control console, which serves to meter and control all gases to an epitaxial reactor with special provision for the diversion of various gas streams to the analyzer console for monitoring purposes. The analyzer section has provisions for either continuous or batch sampling. When a gas stream is under continuous sample the response time to impurity changes of the analyzer is less than 2 seconds. The sensitivity of the system, however, is limited to the detection of a practical, minimum, gas-phase impurity level of 10 = ppm. The gas control console is a completely automatic, multilayer epitaxial growth system. The system has been used to grow flawless, multilayered structures in silicon. Author

N64-33949 Oregon State U., Corvallis
ALL METAL SEALED GAS INFRARED CELL
John D. Hansen and Theran D. Parsons 20 Aug. 1964 4 p refs
(Contract Nonr-1286(04))
(TR-3; AD-604522)

An all metal sealed gas cell for the determination of infrared spectra of reactive gases has been devised. The cell is inert to boron-fluorine compounds and to other nonoxidizing gases. Author

N64-33969 Bell Aerosystems Co., Buffalo, N.Y.
AERO-SPACE ENVIRONMENT SIMULATION SYSTEM (ASESS). VOLUME II: SIMULATION MODELS FOR AERO-SPACE COMMAND AND CONTROL Final Report
Bedford, Mass., AFSC, ESD, Dec. 1963 125p refs
(Contract AF 19(628)-2847)
(ESD-TDR-63-659, Vol. II; AD-604024)

This volume represents the results of various independent analyses in those areas of space dynamics that are associated with the Aerospace Environment Simulation System (ASESS). Included is an orbit determination scheme, which employs advanced techniques in the area of maximum likelihood, as well as space force effectiveness and satellite inspector models, which provide mission analysis capability. In addition, an advanced energy management system for reentry vehicles is reviewed, together with a discussion on orbital rendezvous and docking, both summarizing state-of-the-art analyses in these areas. A technical discussion has been included on the problem of geocentric transfer and rendezvous. Author

N64-33990* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE HYPERTHERMAL SUPERSONIC AERODYNAMIC TUNNEL
H. A. Stine Repr. from High Temp. Technol., 1964 p 85–104 refs
(NASA-RP-360)

The behavior of electric-arc-heated hyperthermal wind tunnels is discussed. The fundamental difficulty with such facilities stems from the lack of adiabatic flow processes necessitated by the requirement for preventing walls of the containing vessel from vaporizing. It is shown that arc behavior is such that a large heat loss from the periphery of the arc column accompanies a high enthalpy in the core. One way to reject the waste heat from the gas and also to minimize the transit time is to provide a cylindrical constrictor tube for the arc discharge, which at the same time is the throat of the wind tunnel. Advantages of this method are discussed, and theoretical and experimental findings agree on the trends of enthalpy with arc current, constrictor radius, gas properties, and mass flow. D.E.W.

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-32792 California U., Berkeley Inst. of Engineering Research
THE STRUCTURE OF THE TURBULENT PRESSURE FIELD IN BOUNDARY LAYER FLOWS
G. M. Corcos Mar. 1963 46 p refs Its Ser. 183, Issue No. 4
(Grant NSF G-11110)

A theoretical interpretation of pressure fluctuation measurements by mathematical equations is presented. In an incompressible turbulent flow, there are two dependent variables—velocity and pressure. The turbulence in the region of maximum production and dissipation is characterized by a velocity field that is driven by, but hardly affects, the pressure field. E.C.

N64-32793 Martin Co., Baltimore, Md.
ON EDDY DIFFUSIVITY, QUASI-SIMILARITY, AND DIFFUSION EXPERIMENTS IN TURBULENT BOUNDARY LAYERS
Mark V. Morkovin Oct. 1963 59 p refs
(RR-42)

The experimental evidence of two zones of quasi-similarity in a plume diffusing from a line source at the wall of a developed turbulent layer is carefully examined for consistency with the concepts of eddy diffusivity. The quasi-similarity of mean temperature profiles within a developed turbulent layer some distance downstream from a step in wall temperature is similarly analyzed. It is concluded that eddy diffusivities when viewed as properties of quasi-similar fields can account for the observed characteristics of the layer developing within another layer to the accuracy of observations. Some consequences of these concepts are explored. Author

N64-32801 Mc Gill U., Montreal (Canada) Mechanical Engineering Research Labs.
CALCULATION OF INTEGRAL PARAMETERS OF A COMPRESSIBLE TURBULENT BOUNDARY LAYER USING A CONCEPT OF MASS ENTRAINMENT
N. M. Standen Aug. 1964 29 p refs
(Grant DRB G-9550-06)
(Rept.-64-14)

The problem of determining the growth of a turbulent boundary layer under conditions occurring on ramjet air intakes is discussed. A modified Stewartson transformation is employed to transform the compressible integral momentum equation to an equivalent incompressible plane, adopting approximate temperature–velocity relations of the Crocco and van Driest form. A semiempirical auxiliary equation, developed for incompressible flow and using the concept of mass entrainment into the boundary layer, is rearranged for use in the transformed plane. The theoretical results obtained by this method are then compared to McLafferty's lag-length theory and to experimental data. It is seen that the mass entrainment theory is in good qualitative agreement with the reported data, and in reasonable quantitative agreement. Author

N64-32828* Connecticut U., Storrs
CONDENSING PRESSURE DROP BY IMPROVED LOCKHART–MARTINELLI METHOD

Fred L. Robson and Winthrop E. Hilding Washington, NASA, Oct. 1964 22 p refs
(Grant NsG-204-62)
(NASA-CR-116) OTS: $0.50

This paper presents a method of predicting the static pressure gradient of a saturated vapor flowing in a round, straight tube with an arbitrary heat flux. The method is based upon a Lockhart–Martinelli-type correlation using, however, experimental data for condensing steam to develop the correlation parameters. The pressure drop is calculated on an incremental basis and summed over the condenser length. The results of this method compare favorably with empirical measurements. Author

N64-32837* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FLOW AND HEAT TRANSFER BETWEEN HEATED PLATES OF FINITE LENGTH IN A FREE-MOLECULE FLOW ENVIRONMENT
Morris Perlmutter Washington, NASA, Oct. 1964 33 p refs
(NASA-TN-D-2209) OTS: $1.00

Solutions for the mass-flow profiles, density, static pressure, temperature, and wall shear distributions for a collisionless gas flowing through a finite-length flat-plate channel are given, and numerical values for particular cases are calculated. The heat transfer between the channel walls and the environment are calculated for the rarefied gas heat transfer as well as for radiant heat transfer. The results indicate that the rarefied gas heat transfer can be significant compared with the thermal radiation for conditions similar to those that occur in a thermionic converter. Author

N64-32839* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
MONTE CARLO SOLUTION FOR THE CHARACTERISTICS OF A HIGHLY RAREFIED IONIZED GAS FLOWING THROUGH A CHANNEL WITH A TRANSVERSE MAGNETIC FIELD
Morris Perlmutter Washington, NASA, Oct. 1964 24 p refs
(NASA-TN-D-2211) OTS: $0.75

The steady flow of a highly rarefied ionization gas through a channel with a magnetic field normal to the channel wall is studied. The solution is obtained by a Monte Carlo procedure. This method consists of following sample ions through the channel. By tallying properties of these ions as they pass scoring cross sections of the channel, the various local properties of the flows such as density, mass flow, energies, and wall shear stress are obtained. These results for the small magnetic field cases were compared with the limiting analytical solutions for no magnetic field and were in good agreement with them. Author

N64-32897* Southwest Research Inst., San Antonio, Tex.
AN EXPLORATORY STUDY OF SIMULATION OF LIQUID IMPACT IN SPACE VEHICLE AND BOOSTER TANKS Technical Report No. 9
John F. Dalzell and Luis R. Garza Sep. 1964 47 p refs
(Contract NAS8-1555)
(NASA-CR-59016) OTS: $2.00 fs; $0.50 mf

This report summarizes exploratory work oriented toward the general problem of liquid impact in space vehicle and booster tanks. General fluid impact simulation studies were carried out with the conclusion that while fluid simulation for the launch abort case is possible in selected circumstances it is doubtful that simulation can be attained for every conceivable case. Similarly successful simulation of the general low gravity case in the laboratory is doubtful though apparently possible in particular instances. Since it does not appear possible to eliminate fluid scale effects in very many cases by experimental design, the magnitude of scale effect must be established. To this end a series of experiments to check for viscous and surface tension scale effects was planned and partially carried out on the fluid impact facility. Author

N64-32933 National Aeronautical Lab., Tokyo (Japan)
STUDIES OF THE FLOW IN A LOW PRESSURE HYPERSONIC SHOCK TUNNEL USING AN ELECTRON-BEAM DENSITOMETER
Isamu Wada Jan. 1963 35 p refs
(NAL-TR-37T)

The flow of a hypersonic shock tunnel using a double diaphragm is analyzed by the method of characteristics in consideration of the growth of the boundary layer in the shock tube and compared with the experimental results measured by an electron-beam densitometer. The density in the test section increases with time according to the boundary layer growth in the medium pressure channel of the shock tunnel and is compared with the computed results of the unsteady flow theory. Some criteria on the effect of the boundary layer and the establishment of the hypersonic flow are given. The density in the boundary layer on a body at a hypersonic speed is also measured by the densitometer. Author

N64-32939 Aix-Marseilles U. (France) Inst. de Mecanique des Fluides de Marseille
A SHOCK TUBE STUDY OF THE CONDUCTIVITY OF A GAS IONIZED BY THE PASSING OF THE SHOCK WAVE [ETUDE, DANS UN TUBE A CHOCS, DE LA CONDUCTIVITE D'UN GAZ IONISE PAR LE PASSAGE DE L'ONDE DE CHOC] Study A
M. Billiotte, G. Inglesakis, and H. Guenoche [1964] 86 p refs In FRENCH
(Contract DRME-63-34042-01-480-75-01)

Shock-tube methods of measuring the electrical conductivity of a gas are reviewed, and their shortcomings are indicated. A method is presented that eliminates many of these disadvantages and has been used to obtain precise values of the conductivity of argon plasmas, in good agreement with theoretical values. In this method, two identical coils, concentric to an insulated tube, are supplied in parallel. Their windings are such that the magnetic fields produced are in opposition. A detector coil is placed perpendicular to the axis of the tube to measure the magnetic flux when a conductor is introduced that deforms the induction lines and destroys the symmetry of the field. The change in force is observed on an oscilloscope. This method is extremely accurate when the tube pressure is not lower than 3-mm Hg. M.P.G.

N64-32940 France Ministere de l'Air, Paris
CONTRIBUTION TO THE STUDY OF THE DISINTEGRATION OF LIQUID STREAMS IN MOVING AIR [CONTRIBUTION A L'ETUDE DE LA DESAGREGATION DES JETS LIQUIDES DANS L'AIR EN MOUVEMENT]
Francis Debeauvais Serv. de Doc. Sci. et Tech. de l'Armement, 1964 96 p refs In FRENCH *Its* Publ. Sci. et Tech. No. 406

The axial sprays produced from a stream of liquid by pressure reduction and by overpressure of air currents are examined by microphotography and cinematography. Two modes of resolution of the liquid jets into drops are distinguished, and the conditions for obtaining each regime are established. Optical studies of the drop images permit tracing the curve of the depth of the field. Quantitative results are presented

for the sprays of water and dibutyl phthalate. Comparisons are made of the average diameter of the drops with those deduced from the formula of Nukiyama and Tanasawa. M.P.G.

N64-32979 Brown U., Providence, R.I.
THE VISCOSITY OF MODERATELY DENSE GASES
Shoon Kyung Kim and John Ross Sep. 1964 33 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(BRN-13-P; AD-448076)

This article presents an analysis of one contribution to the initial density dependence of the viscosity of a gas and the variation of this dependence with temperature. The study is based on a simple model of a triple collision, and the Chapman–Enskog theory of the viscosity of a binary mixture is applied. It was concluded that the physical origin of the initial density dependence of viscosity requires the consideration of attracting forces. G.G.

N64-33007 United Aircraft Corp., Sunnyvale, Calif. United Technology Center
THE FAR-FIELD FLOW OF A SUPERSONIC JET EXHAUSTING INTO A PARALLEL FLOWING STREAM
Richard S. Rosler 5 Aug. 1963 28 p refs
(UTC-TM-14-63-U35)

Mass, momentum, and energy balances are used to derive expressions for the centerline velocity, temperature, gas constant, and specific heat (including the gross effects due to afterburning) vs diameters from the jet exit for the case of arbitrary free-stream velocity. Calculation procedures are summarized. Author

N64-33023 Rensselaer Polytechnic Inst., Troy, N.Y.
TWO PAPERS ON THE CONVERGENCE OF THE GALERKIN METHOD
R. C. Di Prima and R. Sani 27 May 1964 29 p refs
(Contract Nonr-591(08); NSF GP-2337)
(RPI-63; AD-601673)

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1. THE CONVERGENCE OF THE GALERKIN METHOD FOR THE TAYLOR-DEAN STABILITY PROBLEM R. C. Di Prima and R. Sani 11 p refs (See N64-33024 24-11).

2. CONVERGENCE OF A GENERALIZED GALERKIN METHOD FOR CERTAIN FLUID STABILITY PROBLEMS R. Sani 17 p refs (See N64-33025 24-11).

N64-33024 Rensselaer Polytechnic Inst., Troy, N.Y.
THE CONVERGENCE OF THE GALERKIN METHOD FOR THE TAYLOR-DEAN STABILITY PROBLEM
R. C. Di Prima and R. Sani *In its* Two Papers on the Convergence of the Galerkin Method 27 May 1964 11 p refs (See N64-33023 24-11)

The use of Galerkin method to solve the eigenvalue problems that result from investigations in hydrodynamic and hydromagnetic stability is discussed. Consideration of the Taylor–Dean stability problem leads to the sixth-order system $(D^2-a^2)^2u = f(x)v$, $(D^2-a^2)v = -a^2Tg(x)u$, on $0 \leq x \leq 1$ with the boundary conditions $u = v = Du = 0$ at $x = 0$ and $x = 1$. Where D denotes differentiation with respect to x, a is the dimensionless wave number of the disturbance; f(x) and g(x) are known continuous functions; and T is a parameter depending upon a characteristic velocity of the system. It is shown that for the nonselfadjoint eigenvalue problem presented, the approximate eigenvalues as determined by the Galerkin method converge to the exact eigenvalues as the number of terms in the series for u and v are increased. The proof is based on the following theorem: Let λ be a parameter in the equation $Aw - \lambda Kw = 0$ where A and K are linear operators, and the domain of A, D_A is a linear manifold that is dense in Hilbert space H with inner product (,). P.V.E.

N64-33025 Rensselaer Polytechnic Inst., Troy, N.Y.
CONVERGENCE OF A GENERALIZED GALERKIN METHOD FOR CERTAIN FLUID STABILITY PROBLEMS
R. Sani *In its* Two Papers on the Convergence of the Galerkin Method 27 May 1964 17 p refs (See N64-33023 24-11)

The convergence of a generalized Galerkin method and the extended Pellew and Southwell method is considered in detail for a system of equations that is a prototype of the one encountered in many stability problems. By slight modifications, the convergence proof presented can be extended to many other stability problems. In discussing the generalized Galerkin method, some properties of the operators appearing in the mathematical representation are established, and the convergence of the method is established for the problem under consideration. P.V.E.

N64-33052 France Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux
A NEW METHOD OF ANALYSIS OF ATMOSPHERIC TURBULENCE [UNE NOUVELLE METHODE D'ANALYSE DE LA TURBULENCE ATMOSPHERIQUE]
Gabriel Coupry [1964] 17 p refs In FRENCH Presented at 4th Congr. of the Intern. Council of Aeron. Sci., Paris, 24–28 Aug. 1964
(TP-ONERA-TP-114(1964)

Efforts to obtain a better knowledge of turbulence and its influence on the safety of aircraft and the comfort of passengers are described. Following the concepts of Press, turbulence is regarded as locally stationary and gaussian, and the form of the power spectrum is considered invariable. It is then possible to show that the modal scheme can be used, and that this representation, which is the same for cutting stresses and bending moments, is rapidly convergent. The use of the formulas of Rice and the rule of Miner permits the specification of the fatigue life of the structure and the probability of encountering an unacceptable gust. Technical problems encountered with Mystere IV and Mirage III aircraft are described, and the technique for obtaining the quadratic variations and the power spectra is indicated. Positive results obtained in the verification of the invariance of the form of the power spectra and the locally gaussian course of turbulence are also given. M.P.G.

N64-33053 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
VIBRATIONS WITHIN FLUIDS [VIBRATIONS AU SEIN FLUIDES]
Robert Legendre [1964] 52 p In FRENCH Presented at 11th Congr. of Appl. Mechan., Munich, 30 Aug.–5 Sep. 1964
(ONERA-TP-160(1964))

Many problems of linear vibrations within fluids are first enumerated, and the practical interest in their solution is emphasized. One refinement of the method of predicting the flutter of an isolated wing is then proposed, followed by a study of the interactions of the various elements of an aircraft. The mutual actions of turbomachine blades are considered, and provisional methods of estimating the effects of these interactions are outlined. Trans. by M.P.G.

N64-33069 Rochester U., N.Y. Radiation Chemistry and Toxicology Div.
SOLID HOMOGENEOUS AEROSOL PRODUCTION BY ELECTRICAL ATOMIZATION
Edward P. Yurkstas and Charles J. Meisenzehl 30 Oct. 1964 42 p refs
(Contract W-7401-ENG-49)
(UR-652)

This report describes research into the generation of solid homogeneous aerosols from a source producing uniform, charged droplets from liquid solutions by electrical atomization. The process involves the ejection of the material from a capillary and its disruption in air or other gaseous medium by the application of an electrical field to the material. The development of the method together with the mechanism for uniform droplet and particle formation, the relationships involving the physiochemical properties of the source and the material to be ejected, along with consideration for stable and continuous production of the aerosol, are discussed. Author

N64-33084* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
APPROXIMATE FORMULAS FOR VISCOSITY AND THERMAL CONDUCTIVITY OF GAS MIXTURES
Richard S. Brokaw Washington, NASA, Nov. 1964 20 p refs
(NASA-TN-D-2502) OTS: $0.50

Approximate expressions for the viscosity and thermal conductivity of monatomic gas mixtures have been derived from the rigorous kinetic theory formulas for binary mixtures. The approximations, which are of the Sutherland–Wassiljewa form, are compared with rigorous calculations for binary and ternary mixtures of the noble gases. These approximations are very accurate: maximum errors are three parts in ten thousand for viscosity (He-Ne-Ar at 20° C) and seven parts in ten thousand for thermal conductivity (He-Kr-Xe at 29° C); the corresponding root-mean-square errors for all the calculations are 0.015% for viscosity and 0.036% for thermal conductivity. Author

N64-33185* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INTERCELLULAR MOBILITY OF FLUIDS WITHIN HONEYCOMB-REINFORCED COMMON BULKHEADS (BULKHEAD PURGING)
C. T. Egger, T. J. Carter, and J. B. Gayle 23 Jul. 1964 32 p refs
(NASA-TM-X-53094) OTS: $2.00 fs; $0.50 mf

The flow of gases through annular and rectangular face-sealed honeycomb specimens was studied as a function of pressure drop to develop purging and evacuation procedures for the S-IV vehicle. Extrapolation of steady-state results for laboratory specimens to unsteady-state conditions for full-scale vehicles was accomplished by using an energy–mass transport analogy. The results indicated that mass transport through the honeycomb is fast enough to cause concern but too slow to permit rapid purging or evacuation. Although purging and evacuation times could be greatly decreased by use of perforated honeycomb core material, this would offset any advantages resulting from confining or isolating individual leaks. Author

N64-33259 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux
SPECTRAL DISTRIBUTIONS OF SPACE-TIME CORRELATIONS OF SPEED IN THE CASE OF A TURBULENT BOUNDARY LAYER [REPARTITIONS SPECTRALES DE CORRELATIONS SPATIO-TEMPORELLES DE VITESSES, EN COUCHE LIMITE TURBULENTE]
Alexandre Favre and Jean Gaviglio [1964] 33 p refs In FRENCH Presented at the 11th Intern. Cong. of Appl. Mech., Munich, 30 Aug.–5 Sep. 1964
(ONERA-TP-164 (1964))

Experiments to examine the spectral distribution of duplicate space–time correlations in the boundary layer as a function of the scale of velocity fluctuations are reported. The structure of the turbulent flow is also studied to determine the average speed of the phases and the values of the correlation coefficient as a function of scale and for different distances from the wall. M.P.G.

N64-33276* Sperry Rand Corp., Philadelphia, Pa. Univac Div.
RESEARCH AND DEVELOPMENT IN FLUID LOGIC ELEMENTS Interim Report No. 2, 1 Mar.–31 Jul. 1964
Trevor D. Reader 10 Aug. 1964 27 p refs
(Contract NAS8-11021)
(NASA-CR-59148) OTS: $2.00 fs; $0.50 mf

The development of digital fluid amplifiers is analyzed historically, a few applications of pure fluid digital devices are given, and expected developments are mentioned. Basic design principles of fluid amplifiers, such as wall effect, turbulence amplification, and momentum exchange, are discussed in general. The need for a workable theory of fluid devices is reviewed, along with efforts in this direction. D.E.W.

N64-33279* Yale U., New Haven, Conn. School of Medicine
ENERGY TRANSFER BETWEEN MOLECULES AND ELECTRONICALLY EXCITED ATOMS
M. M. Shahin and S. R. Lipsky Repr. from J. Chem. Phys., v. 41, no. 7, 1 Oct. 1964 p 2021–2026 refs
(Grant NsG-192-61)

The technique of competitive quenching has been used to determine the relative rate constants of O_2, N_2, H_2, CO_2, and CH_4 for quenching of excited argon atoms formed both by the action of β radiation from a tritium source and also by low-energy electron impact. Calculations based on the mean lifetime of these species in the system show that with the exception of nitrogen the quenching process for all the other molecules is highly efficient and energy transfer occurs on every collision. Evidence is also presented to suggest that the excited species formed by collision with β rays are primarily in the $^1P_1$ state and not the $^3P_{0,2}$ metastable states. Author

N64-33282* Grumman Aircraft Engineering Corp., Bethpage, N.Y.
RESEARCH ON MOLECULE-SURFACE INTERACTION. PART I: THEORETICAL PREDICTION OF MOMENTUM AND ENERGY ACCOMMODATION FOR HYPERVELOCITY GAS PARTICLES ON AN IDEAL CRYSTAL SURFACE Final Report, 1 Jul. 1963–9 Aug. 1964
Richard A. Oman, Alexander Bogan, and Chou H. Li Sep. 1964 48 p refs
(Contract NASw-709)
(NASA-CR-58957; RE-181J) OTS: $2.00 fs; $0.50 mf

Results from a system of calculations of the three-dimensional interactions of gas molecules with ideal FCC surfaces are presented for a wide range of input conditions. A Lennard-Jones 6–12 potential is assumed between the lattice atoms and the gas particles. The model used is applicable only when the gas particle energy is very much greater than that corresponding to the lattice temperatures. Particular attention is devoted to the validity of approximating the lattice by a system of independent forced harmonic oscillators (i.e., an Einstein lattice). Calculations of interactions of A, Ne, and He on a (100) Ni surface are presented for two incident angles and

four incident energies from 0.125 to 8 eV. Statistical correlations are also presented for 12 different properties of the exit distributions in terms of the 6 independent nondimensional parameters that describe the incident state. Author

N64-33283* Grumman Aircraft Engineering Corp., Bethpage, N.Y.

RESEARCH ON MOLECULE-SURFACE INTERACTION. PART II: EXPERIMENTS ON THE FORMATION OF A SHOCK TUBE DRIVEN MOLECULAR BEAM Final Report, 1 Jul. 1963–9 Aug. 1964

Richard A. Oman and Vincent S. Calia Sep. 1964 22 p refs
(Contract NASw-709)
(NASA-CR-58958; RM-240) OTS: $1.00 fs; $0.50 mf

Experiments on several problems involved in the formation of a shock-tube-driven molecular beam are described. Particular attention is devoted to unsteady (starting) effects on skimmers and to measurements of stagnation heat transfer in the flow field upstream of the skimmer. The results of these experi-

N64-33287* Martin Co., Denver, Colo.

STUDY OF TERMINAL DRAINING FOR LIQUID OXYGEN AND LIQUID HYDROGEN PROPELLANTS Final Summary Report

J. J. Traxler and A. P. Lane Aug. 1964 158 p refs
(Contract NAS8-5417)
(NASA-CR-59255; Martin-CR-64-47) OTS: $5.00 fs; $1.00 mf

A mathematical model is derived for describing vortexing outflow behavior in a central outlet of a cylindrical tank with a convex lower dome. The derivation is based on the constancy of circulation and on the value of the gravitational potential gradient. Two methods of designing propellant tank outlets to minimize propellant residuals are presented. The first, the noncavitating outlet concept, defines an outlet profile that maintains the flowing liquid static pressure constant throughout the outlet. The second concept, the nondropout outlet approach, employs the solution of the two-dimensional Bernoulli equation with the constraint that maintains a flat velocity profile in the outlet, i.e., insures a geometrically flat liquid surface as terminal draining occurs. All mathematical models requiring automatic machine computation have been programed for the IBM 1620 computer, and sample program listings are presented in this report. Author

N64-33297 New York U., N.Y. Courant Inst. of Mathematical Sciences

SOLITARY WAVES IN COMPRESSIBLE MEDIA

M. C. Shen Jul. 1964 102 p refs
(Contract Nonr-285(55); Grant NSF-GP-1669)
(IMM-NYU-325; AD-606792)

Solitary waves in compressible media of finite depth and infinite depth are studied. The critical speeds are first obtained from the linearized equations and then confirmed by the results of the nonlinear theory. Explicit expressions for the solitary waves are established by a perturbation scheme applied to the nonlinear equations. The case of a polytropic compressible medium of finite depth at rest in the state of equilibrium is studied. Solitary waves in compressible medium of infinite depth are investigated. The former concerns two isothermal layers at rest in the state of equilibrium separated by a contact surface; the latter, an isothermal layer with nonuniform velocity distribution at equilibrium. Author

N64-33439 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

FACTORS AFFECTING BOUNDARY LAYER TRANSITION AT HYPERSONIC SPEEDS [FACTEURS AGISSANT SUR LA TRANSITION DE LA COUCHE LIMITE AUX VITESSES HYPERSONIQUES]

R. Michel (ONERA) London, Min. of Aviation, Aug. 1964 16 p refs Transl. into ENGLISH of a paper presented at the 3rd Intern. Cor. in the Aeron Sci., Stockholm, 27–31 Aug. 1962
(RAE-TRANS.-1073)

This paper presents and discusses the preliminary experimental results obtained at approximately Mach 7 in a wind tunnel at high unit Reynolds numbers. Visualization and calculation of the boundary layers have made it possible to determine the transition region on ogives and cone–cylinders with various apex angles. The variation in apex angle and the consequent variation in the pressure gradients on the forebody result in a considerable variation in transition Reynolds number based on local conditions. The transition region length is of the order of magnitude of the laminar distance—a very considerable thickening of the boundary layer occurs during transition; the apparent friction in the transition region is very much greater than the turbulent friction. Author

N64-33441 General Electric Co., Philadelphia, Pa. Missile and Space Div.

DEPARTURES FROM THE SAHA EQUATION IN AN OPTICALLY THIN NITROGEN GAS

J. L. Kulander Sep. 1964 101 p refs Presented at the 1964 Opacity Conf., Albuquerque, N. Mex., 3–4 Sep. 1964
(R64SD62)

The populations of the excited and ionized states in an ionized nitrogen gas are calculated for various steady-state nonlocal thermodynamic equilibrium (NLTE) situations. The nonequilibrium conditions basically result from the low electron densities (10^{11} to 10^{18} e/cm^3) considered. A model consisting of 26 energy levels is assumed for the ions NI–NVIII. The geometrical model consists of a plane-parallel semi-infinite optically thin layer that is assumed to be maintained at a fixed electron temperature and is irradiated by an external planckian field weakened by a dilution factor, W. Specific densities and temperatures for which LTE holds (for the particle occupations) in N are presented. The electrons are assumed to have a maxwellian distribution. The populations are presented for electron temperatures, T_e, and external radiation temperatures, T_r, between 10^4 and 10^6 ° K for various W's. Author

N64-33472 California U., Berkeley Institute of Engineering Research

A DYNAMICAL THEORY OF INTERACTING CONTINUA

A. E. Green and P. M. Naghdi Aug. 1964 19 p refs
(Contract Nonr-222(69))
(AM-64-13; AD-605548)

A dynamical theory of the flow relative to each other of two continua (which includes a dynamical theory of diffusion) is developed from an energy equation and the use of invariance conditions under superposed rigid-body motions, together with an entropy production inequality. Author

N64-33475 Massachusetts Inst. of Tech., Cambridge Hydrodynamics Lab.

TURBULENT WAKES IN DENSITY STRATIFIED FLUIDS OF FINITE EXTENT Report No. 65

Edmund A. Prych, Frederick R. Harty, Jr., and John F. Kennedy Jul. 1964 75 p refs
(Contracts Nonr-1841(76); Nonr-1841(59))
(R64-26; AD-604103)

Presented are the results of an investigation of the effects of a free surface and density stratification of the turbulent transfer of mass and momentum in two-dimensional wakes. The effect of depth of submergence on the drag of a two-dimensional body was also investigated. Author

N64-33476 California Inst. of Tech., Pasadena Flight Sciences Lab.
NITROGEN INJECTION INTO THE BASE REGION OF A HYPERSONIC WAKE
Robert T. Herzog 15 Aug. 1964 75 p refs
(Contract DA-31-124-ARO-(D)-33; Proj. Defender)
(MEMO-71; AD-441099)

An experimental investigation was made of the changes occurring in the near wake of a cylinder at M = 6.0 when nitrogen was injected into the base region. The free-stream Reynolds number based on cylinder diameter was 30 000 and the rate of injection was varied from zero to 3% of the frontal area free-stream mass flow. Pitot pressure profiles across the wake, schlieren photographs, and measurement of the boundary-layer separation point on the cylinder were used to define the changes in wake geometry. Static pressure and temperature surveys were made along the wake centerline starting at the base of the cylinder and continuing downstream to X/D = 6.0. The injection reduced the recompression in the neck region and left only a slight isentropic compression in place of the strong wake shock. The recirculation of mass in the base region was eliminated with approximately 1.5% injection. Author

N64-33478 Suffield Experimental Station, Ralston, Alberta (Canada)
A LISTING OF BASIC SHOCK WAVE RELATIONS
J. C. Muirhead 23 Jul. 1963 5 p
(PMMP-175)

The basic relations for transition across a shock front, and for the generation of shock waves in a compressed gas-driven shock, are presented in terms of the Mach number of the incident shock front. Equations for the following parameters are presented: incident pressure, incident overpressure, density, temperature and sound velocity, particle velocity, dynamic pressure, reflected pressure, reflected overpressure, reflected density, and reflected temperature and sound velocity. P.V.E.

N64-33501 Bureau d'Analyse et de Recherche Appliquees, Issy-les-Moulineaux (France)
ANALOG STUDY OF HYDROFOILS NEAR THE FREE SURFACE
Daniel Fruman Apr. 1964 43 p
(Contract N62558-3645)
(AD-602430)

This report refers to the determination of the camber and thickness distribution concerning a profile placed near the free surface of a flow when the pressure-distribution law along the chord is given. An analog model is determined by application of a formula gained from the classical linearized hypothesis applied to this type of flow. In addition to the agreement of the model test results with the calculation assumptions, it is also pointed out that the linear theory of small perturbations is only justified in hydrodynamic tests. G.G.

N64-33511* Southwest Research Inst., San Antonio, Tex.
BUBBLE BEHAVIOR IN LIQUIDS CONTAINED IN VERTICALLY VIBRATED TANKS Technical Report No. 4
Daniel D. Kana and Franklin T. Dodge 1 Aug. 1964 50 p refs
(Contract NAS8-11045)
(NASA-CR-59234) OTS: $2.00 fs; $0.50 mf

Violent bubble behavior observed in liquids contained in a vertically vibrating tank is analyzed both theoretically and experimentally. The behavior is characterized by the occurrence of bubble motions that are contrary to usual buoyancy conditions, and of a pressure resonance well below the resonant frequency of a pure liquid column. The most violent part of the behavior is a result of a water hammer pressure resonance in a bubbly liquid–air mixture contained in an elastic tank. The theory set forth explains the entire behavior quite satisfactorily as evidenced by good agreement between the theory and experiments for the conditions studied. Author

N64-33575 Purdue Research Foundation, Lafayette, Ind.
INCOMPRESSIBLE FLOW IN CONICAL DIFFUSERS Technical Report No. 1
Alan T. Mc Donald (Ph.D. Thesis) and Robert W. Fox Sep. 1964 204 p refs
(Contract DA-31-124-ARO(D)-138)
(AROD-4332-1; AD-448505)

Experiments have been performed using water flow in clear plastic diffusers, discharging into a plenum tank, in order to obtain performance and flow regime information for a range of diffuser geometries. The principal conclusions of the study were the following: (1) A line of first appreciable stall has been located with sufficient precision that it is useful in conical diffuser design. (2) Performance data have been obtained to allow solution of the four common optimum problems encountered in diffuser design. At present, these solutions can be extrapolated only with caution to other diffuser geometries. (3) The optimums located for conical diffusers are not the same as those suggested by data from tests of plane walled diffusers. Author

N64-33581 Suffield Experimental Station, Ralston, Alberta (Canada)
A BRIEF NOTE ON SOME INTERESTING SHOCK WAVE RELATIONS
J. C. Muirhead 3 Jan. 1963 3 p refs
(PMMP-160)

It is noted that the overpressure in a reflected shock wave is not readily accounted for by summing the incident overpressure and the dynamic pressure Pd_2 where $Pd_2 = 1/2\rho_2 U_2^2$ and ρ_2 = density behind the shock front and U_2 = particle velocity behind the shock front. Formulas are derived from the equations of Glass, Martin, and Patterson that account for the noted discrepancies. D.E.W.

N64-33602* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
SURFACE PRESSURE AND TURBULENT AIRFLOW IN TRANSVERSE RECTANGULAR NOTCHES
Jay Fox Washington, NASA, Nov. 1964 20 p refs
(NASA-TN-D-2501) OTS: $0.50

Surface-pressure coefficients C_p and airflow measurements in transverse rectangular notches of length-to-height ratio L/H from 1/4 to 1 3/4 are presented. Free-stream speeds range from 160 to 600 fps. Agreement with previous low-speed measurements of C_p exists in many instances, but some unique results are also obtained. Ranges of L/H are postulated wherein similar values of C_p may be found for similar L/H. First effects of compressibility are discernible in the results. Notch flow dynamics are studied in selected notches in different L/H ranges by means of turbulence intensity measurements, mean-speed surveys, and dust patterns. Author

N64-33651 Hydronautics, Inc., Laurel, Md.
LINEARIZED THEORY FOR A SUPERCAVITATING HYDROFOIL OPERATING IN A FLUID OF FINITE DEPTH
Hung-Ta Ho Jun. 1963 30 p refs
(Contract NObs-84296)
(TR-119-7; AD-601101) OTS: $2.60

The present study applies linearized theory to a two-dimensional, uniform, supercavitating flow passing over a hydrofoil operating near the surface of a fluid of finite depth. The problem is formulated in the region of the lower half of a transformed plane, and the formulation is applicable to foils of any shape within the scope of the linearized theory and of any location between the free surface and the bottom of the channel. For the case of a flat plate the solution is obtained in terms of Legendre elliptic integrals. Numerical calculations are made for the lift and moment coefficients of the foil immersed at several different distances under the free surface with varying water depths. Author

N64-33652 Texas U., Austin Defense Research Lab.
SUMMARY OF STUDIES ON THE MEASUREMENT OF LOCAL SKIN FRICTION BY MEANS OF THE SURFACE IMPACT OR PRESTON TUBE
J. C. Westkaemper and Oliver Hill 18 Feb. 1964 52 p refs
(Contract NOrd-16498)
(DRL-513; CR-9)

This report summarizes the work done on the use of the surface impact probe, or Preston tube, method of measuring skin friction in turbulent, compressible boundary layers. The theory for incompressible flow was extended to the case of adiabatic, compressible flow, and the extended theory was experimentally shown to be valid. It has also been demonstrated that the extension is applicable to adiabatic flow with moderate adverse pressure gradients. Experimental and theoretical efforts to apply the impact probe method to compressible flows with moderate, aerodynamic heating were only partially successful. Author

N64-33656 General Applied Science Labs., Inc., Westbury, N.Y.
A FINITE DIFFERENCE METHOD SOLUTION OF NON-SIMILAR, NON-EQUILIBRIUM AIR, LAMINAR AND TURBULENT BOUNDARY LAYER FLOWS. PART III: INPUT DATA MANUAL Final Report
Lawrence S. Galowin and Harry E. Gould 19 Mar. 1964 29 p
(Contract DA-30-069-ORD-3531; ARPA Orders 51-60, 51-61, and 51-62; Proj. Defender)
(TR-422; AD-442890)

This input-data manual provides detailed information on the input-data preparation for the solutions of laminar or turbulent boundary-layer problems. Extensive controls are incorporated through input specifications. All the codes for the specification of body and shock geometry for stream conditions and other parameters, and all of the program switch settings, are presented in detail. Those parameters and tolerance values that running experience showed to be satisfactory or practical are indicated. The relevant physical relationships for boundary-layer-thickness calculation, local Reynolds number, and spatial distributions in the physical plane are also discussed. G.G.

N64-33660 Louisiana State U. and Agricultural and Mechanical Coll., Baton Rouge
THE FLOW OF SUPERFLUID HELIUM Quarterly Progress Report, 1 Mar.–31 May 1964
Joseph M. Reynolds, Robert G. Hussey, Devron P. Thibodeaux, and Raymond F. Folse, Jr. Wright-Patterson AFB, Ohio, AF Mater. Lab. [1964] 9 p refs
(Contract AF 33(657)-8941)
(QPR-6; AD-447817)

Expressions are presented for the inertia and drag coefficients of an oscillating infinite plane and an oscillating sphere for the case of damped harmonic motion. Similar expressions, valid only for small penetration depths, are presented for the more complicated problem of an oscillating infinite cylinder. Measurements have been made with oscillating cylinder pairs in liquid helium at amplitudes up to 0.3 radian (linear amplitudes up to 0.6 cm). The observed critical amplitudes are correlated with an empirical expression that involves the superfluid density and the Gorter–Mellink mutual friction coefficient. Measurements with oscillating disks show no critical amplitudes in this range. Author

N64-33683* Yale U., New Haven, Conn.
CONDUCT RESEARCH ON GAS CHROMATOGRAPHIC SYSTEMS TO ANALYZE CERTAIN CHEMICAL CONSTITUENTS OF THE SURFACE OF THE MOON Progress Report, 1 Feb.–31 Jul. 1964
[1964] 4 p ref
(Grant NsG-192-61)
(NASA-CR-59301) OTS: $1.00 fs; $0.50 mf

Studies of certain ionization phenomena in gases were made to detect the processes responsible for the presence of permanent as well as other gaseous samples in ionization detectors being used in gas chromatography, and for a research program concerning parameters used in the analysis of various gases comprising planetary atmospheres, as well as the presence of organic compounds on planetary surfaces. G.G.

N64-33700 Texas U., Austin Defense Research Lab.
DETACHED SHOCK FRONTS-EXTENSION OF ATTACHED CURVED SHOCK FRONT ANALYTICAL METHODS
P. H. Miller 11 Feb. 1964 41 p refs
(Contract NOrd-16498)
(DRL-512; CR-8; AD-450800)

An analytical expression previously derived to describe the shape and position of attached curved shock fronts has been extended, by means of a slight modification of the coordinate system origin, to the cases of detached curved shock fronts. Theoretical and experimental results were compared and the agreement was shown to be excellent. Author

N64-33709 Lockheed Missiles and Space Co., Sunnyvale, Calif. Physical Sciences Lab.
APPROXIMATION TECHNIQUES FOR RADIATION-HYDRODYNAMICS COMPUTATIONS
R. W. Hillendahl Feb. 1964 48 p refs *Its* Rept.-3-27-64-1
(Contract DA-49-146-XZ-198)
(DASA-1522; AD-446510)

The formulation of problems in which radiative transfer of energy occurs simultaneously with hydrodynamic processes is discussed for one-dimensional Lagrangian systems. The partial differential equations describing the motion of the fluid are solved simultaneously with the equation of transfer of radiation by use of numerical methods. The radiative flux divergence is formulated in terms of an integral form of the equation of transfer. Following a brief discussion of the radiative diffusion and plane parallel geometry cases, which can be treated exactly, a representative-ray approximation is described that is more generally applicable and reduces to these more restricted formulations under the appropriate limiting conditions.

Spectral averaging is carried out by the averaging of transmission-like functions defined in terms of the integral equation of transfer for finite slabs. A basic radiation-hydrodynamics code for a one-dimensional spherical geometry is described. Author

N64-33736 Suffield Experimental Station, Ralston, Alberta (Canada)
A QUESTION ON SHOCK WAVE THEORY
J. C. Muirhead 18 Jun. 1963 2 p refs
(PMMP-174)

The number 1.86 is the common factor for three divergent unrelated equations that are common to the shock-wave theory. The author asks if there is any physical connection between these three results or if the number occurs merely by chance. J.L.C.

N64-33738 Pennsylvania State U., University Park
IN-FLIGHT MEASUREMENTS OF THE GENERATION AND DECAY OF A TRAILING VORTEX SYSTEM
Barnes W. McCormick [1964] 21 p refs Presented at the Intern. Union of Theoret. and Appl. Mech. Symp. on Concentrated Vortex Motions in Fluids, Ann Arbor, Mich., 6–11 Jul. 1964

The generation, roll-up, and decay of a trailing vortex system are being investigated over a wide range of Reynolds numbers, using both small wind-tunnel models and full-scale in-flight measurements. M.P.G.

N64-33739 France Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux
THE INFLUENCE OF CHEMICAL REACTIONS UPON FLOW [INFLUENCE DES REACTIONS CHIMIQUES SUR L'ECOULEMENT]
Marcel Barrère [1963] 87 p refs In FRENCH Presented at the AGARD Symp. on Supersonic Flow with Chem. Reactions and Heat Transfer by Radiation, London, 1–5 Apr. 1963
(ONERA-TP-10(1963))

After reviewing fundamental rules of flow in which chemical reactions are produced and the principal chemical reactions in rocket-motor exhausts, certain catalytic mechanisms that are able to influence the speed of these reactions are considered. In the case of equilibrium reactions, the variation of entropy is shown to play a fundamental role; the production of entropy per unit time depends on the reactive processes. It is also shown that the evolution of spaces along the flow becomes characterized by three partial derivatives, the first of which is related to the specific heat of the gas, and the other two define the evolution of the number of moles at constant temperature and pressure. When the chemical evolution of the fluid is outside equilibrium, the classical thermodynamic equations can be used to deduce the chemical relaxation. It is shown that the speed of propagation of sound in a flow undergoing a chemical reaction depends not only on the calculated speed of sound, but also on the chemical relaxation time and the frequency of the perturbation. Finally, real flows in rocket exhausts are analyzed, using the method of Bray together with linearization procedures. M.P.G.

N64-33762 Aerojet-General Corp., Downey, Calif. Research and Engineering Div.
COALESCENCE OF WATER DROPS Semiannual Progress Report, 1 Aug. 1963–31 Jan. 1964
D. C. George and E. Motter 12 Feb. 1964 10 p
(Contract DA-36-039-AMC-03378(E))
(Rept. -0817-01(01)SP; AD-445348)

The effect of electrostatic charge and drop environment on coalescence times has been investigated. This report considers some of the more detailed mechanisms controlling coalescence time. Author

N64-33768* Martin Co., Denver, Colo.
MECHANICS OF GEYSERING OF CRYOGENICS Summary Report, 1 Jul. 1963–30 Jun. 1964
D. W. Murphy Jun. 1964 42 p refs
(Contract NAS8-5418)
(NASA-CR-59321; NASA-CR-64-3(Issue 7)) OTS: $2.00 ft; $0.50 mf

The study consisted of developing a method for the prediction of geysering and nongeysering combinations of system geometry, fluid properties, and heating rate. An experimental program, based on work done by others in conjunction with free convection cooling of turbine blades, was conducted, which resulted in an empirical correlation for the prediction of geysering. This correlation was based on the results of 114 geyser tests using water, Freon 113, liquid nitrogen, and liquid hydrogen as test fluids. In addition, a limited effort was expended to qualitatively investigate the feasibility of four methods of geyser suppression—base heating, horizontal tube at the base of the geyser tube, concentrated heat flux on the geyser tube, and concentric tube in the geyser tube. Author

N64-33774* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
OBLIQUE SHOCK WAVE ANGLE CHARTS FOR A PERFECT GAS (γ = 1.20, 1.26, 1.40, AND 1.67)
Floyd R. Livingston 15 Mar. 1964 19 p refs
(Contract NAS7-100)
(NASA-CR-59341; JPL-TM-33-162)

When operating in the perfect gas regime of planetary atmospheric gases in conventional wind tunnels and in solving two-dimensional flow problems, the aerodynamicist requires charts illustrating the variation of oblique shock-wave angle with turning angle. For this purpose, the oblique shock-wave angle as a function of turning angle has been computed for Mach numbers to 10 in accordance with the shock theory. Specific heat ratios of 1.20, 1.26, 1.40, and 1.67 were used. Using the proper trigonometric relations, these charts may be used in conjunction with normal shock tables to obtain the thermodynamic characteristics of a perfect gas behind an oblique shock wave. Author

N64-33819 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
AN INVESTIGATION OF THE POSSIBILITY OF ELECTRICALLY ATOMIZING VOLATILE LIQUIDS
Gary Culp (M.S. Thesis) Aug. 1964 90 p refs
(GSP/Phys-64-1; AD-603682)

Liquids studied included distilled water, ionically doped water (H_2SO_4 in H_2O), and liquid nitrogen. The liquids were forced under pressure through small metal capillary tubes held at high positive potentials with respect to a nearby ground plate. Liquid nitrogen was studied at atmospheric pressure and in vacuo; water was investigated only in vacuo. Particles sprayed from the capillary tubes were monitored with charged particle detectors to measure any net electrical charge. Resulting sprayed particles in all cases had net charge insufficient to be detected above background noise. The lack of charge on the sprayed particles can be explained by analysis of the key times required for ion separation in the liquid versus the time the ions spend in the electric field (a study of liquid velocity versus ion mobility). Author

N64-33825 Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.

RE-EXAMINATION OF NUCLEATION AND CONDENSATION OF WATER

Welby G. Courtney Jul. 1964 57 p refs Submitted for Publication

(Contract Nonr-4154(00))

(AD-443693)

This paper presents a critical reexamination of several nucleation theories (excluding the surface-energy problem) and concludes that Kuhrt's thermodynamic theory for cluster formation in monoatomic vapor, which follows the classical liquid-drop model but conserves degrees of freedom, is procedurally correct. The Kuhrt approach is extended to polyatomic vapors. Assuming that nonatomic vibration modes are equally probable in the condensed phase, the resulting corrosion factors to the classical rate of nucleation are about 10^4, 10^7, and 10^9 particles/cc sec for a monoatomic, linear, and nonlinear condensing molecule. The nucleation of water vapor is examined in detail, and the theoretical rate of condensation is computed for adiabatic constant-volume conditions. Author

N64-33832 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio

EFFECTS OF PARTIAL CONDENSATION AROUND IONS IN ELECTRO-FLUID DYNAMIC ENERGY CONVERSION PROCESSES

John Alvern Decaire (M.S. Thesis) Aug. 1964 87 p refs

(GSP-64; AD-603681)

This investigation is concerned with the direct conversion of fluid dynamic energy into electrical energy. Charges of one sign are seeded into a gas flow and are transported by viscous interaction with the gas molecules against the action of an applied electric field. The effectiveness of the viscous interaction depends on the charge mobility. After being transported a finite distance, the charges are collected and then neutralized by a current flowing through an external load resistance. Author

N64-33864 Space Technology Labs., Inc., Los Angeles, Calif.

FLOW OF GAS-PARTICLE MIXTURES IN AXIALLY SYMMETRIC NOZZLES

James R. Kliegel and Gary R. Nickerson [1961] 33p refs

(TM-7106-0023-MUO; AD-422122)

A previous study of one-dimensional gas-particle nozzle flows has been expanded to treat axially symmetric nozzle-flows. Comparisons between calculated and experimentally measured nozzle efficiencies are given for a metallized double-base propellant whose exhaust contains 38% condensed oxides. The theory predicts the performance of this propellant in nozzles of greatly different size, shape, and expansion ratio, within the limits of the experimental measurements. It is concluded that the theory adequately describes the flow of gas-particle mixtures in axially symmetric nozzles. Author

N64-33888 Massachusetts Inst. of Tech., Cambridge Engineering Projects Lab.

TWO-PHASE GAS-LIQUID FLOW OSCILLATIONS: PRELIMINARY SURVEY

S. William Gouse, Jr. Jul. 1964 50 p refs

(Contract Nonr-1841(73))

(DSR-8734-5; AD-603652)

A review of a representative number of references for various types of two-phase gas-flow oscillations has been conducted. The principal conclusion is that at this time there is no reliable way to predict the onset, magnitude, frequency, and disappearance of flow oscillations in two-phase flow systems. A consensus of the existing experimental results indicates that the tendency for a system to oscillate can be reduced by reducing the inlet subcooling, increasing the system pressure level, eliminating heated-section exit restrictions, decreasing fluid level in a riser, if present, and increasing the flow restriction at the heated section inlet. In addition, it is believed that useful stability maps can be prepared that indicate regions of operation in which there will be no flow oscillations. For a given fluid system, the parameters necessary to determine this map are geometry, inlet subcooling, flow rate, and heat flux. Author

N64-33931 Naples U. (Italy) Inst. of Aeronautics

PROPAGATION OF ELECTROMAGNETIC WAVES IN AN INHOMOGENEOUS MEDIUM Technical (Final) Report

L. G. Napolitano Feb. 1964 42 p refs

(Contract AF 61(052)-548)

(IA-115; AFCRL-64-758; AD-606829)

In studying the thermodynamics and dynamics of ionized gases, a nonrelativistic phenomenological theory, satisfying the Lorentzian invariance of thermodynamic quantities and not based on any a priori assumption for the form of the electromagnetic momentum density, is developed for an arbitrary polarizable medium. The influence of finite ionization rates on wave propagation through ionized gases is dealt with by using both the one-fluid model and the Lenhert two-fluid model for the plasma. Author

N64-33980 Massachusetts Inst. of Tech., Cambridge National Magnet Lab.

TWO PHASE FLOW IN CAPILLARY TUBES

Mikio Suo and Peter Griffith Mar. 1963 101 p refs

(Contract AF 19(604)-7344)

(TR-8581-24; AD-402012)

The flow of two phases, gas and liquid, has been studied in horizontal tubes of capillary diameter. The flow has been primarily studied in the regime where the gas flows as long bubbles separated from the wall of the tube by a liquid film and from each other by slugs of liquid. In this regime the pressure drop, density, and, to a certain extent, the thickness of the liquid film around a bubble have been correlated. The conditions under which the long bubble flow can exist and under which the correlations are valid have been determined. Of special interest is that the correlations should be valid in a zero-gravity field. Author

N64-34012* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

CALCULATIONS OF REAL-GAS EFFECTS IN FLOW THROUGH CRITICAL-FLOW NOZZLES

Robert C. Johnson Repr. from J. Basic Eng., Sep. 1964 8 p refs Presented at the ASME Winter Ann. Meeting, Philadelphia, 17–22 Nov. 1963

(NASA-RP-356; ASME Paper-63-WA-71)

Computer calculations have been made of how real-gas effects modify the conventional one-dimensional equations for mass flow of air, nitrogen, oxygen, hydrogen, argon, and helium. The results indicate that for critical flow of air, at room temperature and 100 atm pressure, real-gas effects of 3 1/2 percent exist. Similar magnitudes are found for the other gases. Author

N64-34018* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALYTICAL INVESTIGATION OF REDUCTION IN TURBULENT SKIN FRICTION ON A FLAT PLATE BY MEANS OF AIR INJECTION THROUGH DISCRETE SLOTS

K. R. Czarnecki Washington, NASA, Nov. 1964 61 p refs (NASA-TN-D-2102) OTS: $1.50

The analysis is based on the combination of the momentum losses in the boundary-layer and injection airflows, and employs the Sommer and Short reference temperature method for estimating boundary-layer skin friction. The results of the analysis indicate that the greatest theoretical reductions in skin friction occurred at the lowest injection-air-pressure recovery factors defined as the fraction of free-stream dynamic pressure energy still preserved in the injection engine or bleed air after entrance losses, and thus at the lowest air injection velocities. For the optimum set of conditions considered in the analysis, the maximum reduction in skin friction at a Mach number of 3 was about 24% at a recovery factor of 0.005. For an anticipated pressure recovery range of 0.25 to 0.50, the calculated reduction in skin friction with the remaining conditions being held constant was on the order of 10% to 5%. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-32701* National Aeronautics and Space Administration, Washington, D.C.

AURORAE AND AIRGLOW

V. I. Krasovskiy, ed. Oct. 1964 283 p refs Transl. into ENGLISH of "Polyarnyye Siyaniya i Svecheniye Nochnogo Neba" IGY Program, Sect. 4, no. 10, Moscow, Izd. Akad Nauk SSSR, 1963

(NASA-TT-F-204) OTS: $4.00

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N64-32702* National Aeronautics and Space Administration, Washington, D.C.

SPECTRAL DISTRIBUTION OF EXTRA-ATMOSPHERIC AND ATMOSPHERIC COMPONENTS OF THE NIGHT-AIRGLOW CONTINUUM

Yu. L. Truttse *In its* Aurorae and Airglow Oct. 1964 p 1-7 refs (See N64-32701 24-12) OTS: $4.00

Spectral distribution of the extra-atmospheric components of the continuous spectrum of night glow has been measured. It considerably differs from the spectral energy distribution in the class G2 stars. The determination of the spectral distribution of the extra-atmospheric and atmospheric components was performed with the aid of an automatic scanning photometer. Considerable data on observations in Ashkhabad were accumulated. The results obtained may be of substantial assistance in electrophotometric observations carried out with interference filters. Author

N64-32703* National Aeronautics and Space Administration, Washington, D.C.

BACKGROUND MEASUREMENTS DURING PHOTOELECTRIC OBSERVATIONS OF [OI] EMISSION AT λ 5577 Å

Yu. L. Truttse *In its* Aurorae and Airglow Oct. 1964 p 8-17 refs (See N64-32701 24-12) OTS: $4.00

From the analysis of the observation data it is concluded that the background in the region λ 5577 Å has been incorrectly estimated, on the assumption that the ratio I^b_{5577}/I^b_{5300} is equal to that of class G2 stars. The results of measuring I^b_{5577}/I^b_{5300} for stellar and atmospheric continuum components are presented. Author

N64-32704* National Aeronautics and Space Administration, Washington, D.C.

AN ANOMALOUS INCREASE IN THE INTENSITY OF NATURAL ATMOSPHERIC AIRGLOW IN THE REGION λ 5577 Å

Yu. L. Truttse *In its* Aurorae and Airglow Oct. 1964 p 18-20 refs (See N64-32701 24-12) OTS: $4.00

This intensity increase commenced between 1900 and 1930 hours UT. Unfortunately, it was not possible to pinpoint more precisely the instant of this commencement, since it took place during a half-hour pause in the observations. When the observations were resumed at 1930 hours, the spot already existed and its intensity was high. The total disappearance of the spot occurred at approximately 2330 hours. The intensity of the spot throughout its existence fluctuated broadly and in a most random manner, its only fixed tendency being to move in the direction of the horizon. At times the intensity in the individual sections of the spot exceeded the intensity of the [OI] λ 5577 Å line by as much as 600 rayleighs. Diagrams give the variation in the size and shape of the spot with time. Author

N64-32705* National Aeronautics and Space Administration, Washington, D.C.
NIGHT-AIRGLOW EMISSION IN THE ULTRAVIOLET REGION OF THE SPECTRUM
Z. V. Karyagina *In its* Aurorae and Airglow Oct. 1964 p 21–28 refs (See N64-32701 24-12) OTS: $4.00

Results of studies of the ultraviolet spectrum of night-airglow emission are described with reference to observations carried out in Alma-Ata. The absolute intensities of the emissions are presented. Author

N64-32706* National Aeronautics and Space Administration, Washington, D.C.
HYDROXYL EMISSION WITH DIFFERENT VIBRATIONAL EXCITATION
M. A. Berg and N. N. Shefov *In its* Aurorae and Airglow Oct. 1964 p 29–38 refs (See N64-32701 24-12) OTS: $4.00

A comparison of intensities and rotational temperatures of OH bands from different vibrational levels shows that excited OH molecules with different vibrational excitation are created at different altitudes due to the effect of different phenomena. Author

N64-32707* National Aeronautics and Space Administration, Washington, D.C'
HYDROXYL EMISSION IN THE UPPER ATMOSPHERE
V. I. Krasovskiy *In its* Aurorae and Airglow Oct. 1964 p 39–59 refs (See N64-32701 24-12) OTS: $4.00

Too high rotational temperature of OH bands indicates that rotational states of hydroxyl are not in thermodynamic equilibrium with the ambient medium. Variations in relative and absolute populations of vibrational levels are an evidence of height changes or processes of appearance of excited hydroxyl. Hydroxyl emission may take place in the absence of atomic hydrogen. Various reactions with vibrationally excited molecules can insure appearance of a number of emissions in the upper atmosphere. Author

N64-32708* National Aeronautics and Space Administration, Washington, D.C.
THE SPATIAL DISTRIBUTION AND VARIATIONS OF H_α EMISSION IN NIGHT AIRGLOW
L. M. Fishkova *In its* Aurorae and Airglow Oct. 1964 p 60–68 refs (See N64-32701 24-12) OTS: $4.00

Spectrographic observations carried out in Abastumani in 1958–1961 have determined the absolute intensity, seasonal variations, and spatial distribution of H_α emission in night airglow. Author

N64-32709* National Aeronautics and Space Administration, Washington, D.C.
OBSERVATION OF CERTAIN WEAK EMISSIONS OF THE NIGHT SKY BY THE ELECTRON TELESCOPY METHOD
P. V. Shcheglov *In its* Aurorae and Airglow Oct. 1964 p 69–74 refs (See N64-32701 24-12) OTS: $4.00

This paper discusses observations of H_α emission in night airglow and helium emission λ 10 830 Å during twilight with the help of the Fabry–Perot interferometer and with a contact electronic image converter. Author

N64-32710* National Aeronautics and Space Administration, Washington, D.C.
AN ATTEMPT TO DETECT ATMOSPHERIC EMISSION DURING THE SOLAR ECLIPSE OF 15 FEBRUARY 1961
F. K. Shuyskaya *In its* Aurorae and Airglow Oct. 1964 p 75–93 refs (See N64-32701 24-12) OTS: $4.00

In the course of the total phase of the solar eclipse spectrographic observations were conducted from an aircraft to study the radiation of the earth's upper atmosphere. Emissions He I λ 10,830, [OI] λ 6300, Na I λ 5896 and 5890, and OI λ 4368 Å have been registered, and their intensities have been estimated. Author

N64-32711* National Aeronautics and Space Administration, Washington, D.C.
PHOTOELECTRIC RECORDING OF INFRARED SPECTRA
O. L. Vaysberg *In its* Aurorae and Airglow Oct. 1964 p 94–96 refs (See N64-32701 24-12) OTS: $4.00

A photoelectric receiver of infrared radiation with low-level threshold is described. Author

N64-32712* National Aeronautics and Space Administration, Washington, D.C.
BEHAVIOR OF λ 10,830 Å HELIUM EMISSION AT TWILIGHT
N. N. Shefov *In its* Aurorae and Airglow Oct. 1964 p 97–112 refs (See N64-32701 24-12) OTS: $4.00

The conditions of excitation of emission λ 10 830 Å at different heights in the atmosphere and for different angles of solar depression have been calculated. With the help of these calculations the solar radiation flux $\lambda << 304$ Å has been determined from the observation data for the period of 1959–1962. Comparison of these data with the solar activity data shows that they are interrelated. Author

N64-32713* National Aeronautics and Space Administration, Washington, D.C.
PATROL OBSERVATIONS OF THE CONTOURS OF THE H_α LINE
O. T. Yurchenko *In its* Aurorae and Airglow Oct. 1964 p 113–121 refs (See N64-32701 24-12) OTS: $4.00

This paper contains the results of processing the auroral spectra of the H_α line, obtained with an SP-47 patrol spectrograph during the International Geophysical Year. Author

N64-32714* National Aeronautics and Space Administration, Washington, D.C.
PROTON INTRUSION IN AURORAE
Yu. I. Gal'Perin *In its* Aurorae and Airglow Oct. 1964 p 122–139 refs (See N64-32701 24-12) OTS: $4.00

Observational results obtained recently on the movements and shape of the "hydrogen field" in auroras make it possible to establish the planetary picture of proton precipitation. The stability of the form of the doppler profile of hydrogen emission, with only minor variations, is confirmed. Sometimes

significant softening of the proton energy spectrum appears. Theoretical considerations on the proton flux anisotropy and corresponding cross sections are briefly reviewed. Author

N64-32715* National Aeronautics and Space Administration, Washington, D.C.
DETERMINING THE RELATIVE POPULATIONS OF VIBRATIONAL LEVELS AND ROTATIONAL TEMPERATURE OF THE SYSTEM OF BANDS $A_2\Pi-X_2\Sigma$ OF N_2^+
N. I. Fedorova *In its* Aurorae and Airglow Oct. 1964 p 140–167 refs (See N64-32701 24-12) OTS: $4.00

The relative population of variation levels of band system $A^2\Pi-X^2\Sigma$ of N_2^+ was determined by using a "flattened" sequence of transition probabilities. A table of calculated values of r-centroids $\bar{r}_{v'v''}$ is presented. Dependence of the electron moment of transition R_e internuclear distance r is determined by three pairs of band intensity relations with a common upper vibrational level and may be expressed by the formula $(1-1,\ 925\ r + 0.950\ r^2)$. The distribution of vibrational level population corresponds to $T_{col} = 2700 \pm 200°$ K. Rotation temperature was determined from (1,0) band of N_2^+ with the help of synthetic contours calculated for the three rotational temperature values: 250°, 375°, and 500° K.
Author

N64-32716* National Aeronautics and Space Administration, Washington, D.C.
RESULTS OF VISUAL OBSERVATIONS OF AURORAE IN 1957–1958
Ya. I. Fel'dshteyn and N. F. Shevnina *In its* Aurorae and Airglow Oct. 1964 p 168–221 refs (See N64-32701 24-12) OTS: $4.00

This paper presents the analysis results of data on visual observations of auroras at 620 stations in the U.S.S.R., mainly located at middle latitudes, for the period of 1957–1958. It also uses data on the position of the southern boundary of occurrence of zenithal auroras on the territories of foreign states in the Northern Hemisphere, as well as in the Southern one. The space-time distribution of auroras is discussed.
Author

N64-32717* National Aeronautics and Space Administration, Washington, D.C.
MORPHOLOGY OF AURORAE AND GEOMAGNETISM
Ya. I. Fel'dshteyn *In its* Aurorae and Airglow Oct. 1964 p 222–229 refs (See N64-32701 24-12) OTS: $4.00

The isoauroras of the daytime and nighttime hours in the Northern and Southern Hemispheres are illustrated. The maximum isoaurora during nocturnal hours corresponds to the inner auroral zone, whereas in the daytime hours it corresponds to the second zone, i.e., to the high-latitude zone. The data presented show that the region of the maximum values of magnetic activity, as well as the oval auroral zone, is located during the daytime hours on higher geomagnetic latitudes than during nighttime hours. The direction and value of the magnetic field disturbance vector can be explained by the fact that current flows in the westward direction along the oval auroral zone. Author

N64-32718* National Aeronautics and Space Administration, Washington, D.C.
AURORAL ISOCHASMS
O. V. Khorosheva *In its* Aurorae and Airglow Oct. 1964 p 230–240 refs (See N64-32701 24-12) OTS: $4.00

If full 24- hour determining periods are used in the occurrence frequency of zenithal auroras, the maximal isochasm will run 4° to 5° poleward of the "basic zone" (Fritz's zone) reflecting the distribution of auroras in night hours of local time. This result is in agreement with the fact of the existence of a single closed auroral ring with a regular diurnal drift around the geomagnetic pole. Author

N64-32719* National Aeronautics and Space Administration, Washington, D.C.
MAKING ALLOWANCE FOR ERRORS IN MEASUREMENTS OF AURORAL POSITIONS BASED ON ASCAFILMS
Yu. A. Nadubovich and I. A. Rudenko *In its* Aurorae and Airglow Oct. 1964 p 241–250 refs (See N64-32701 24-12) OTS: $4.00

This paper investigates the values of errors occurring when projections of auroral position are plotted on maps by the measurements based on ascafilms. The causes of the errors lie in the following: errors in position measurements and frame orientation, neglect of refraction, movement and true height of aurora, etc., as well as cartographic errors. It is proved that for the major part of the S-180 camera frame, these errors amount to several tens of kilometers in the azimuth. Such an accuracy is considered sufficient for solution of the majority of problems connected with research of the geographic distribution of auroras. Author

N64-32720* National Aeronautics and Space Administration, Washington, D.C.
A STUDY OF THE S-180 CAMERA
Yu. A. Nadubovich *In its* Aurorae and Airglow Oct. 1964 p 251–279 refs (See N64-32701 24-12) OTS: $4.00

This paper presents the study of the major features of the patrol all-sky camera for the photography of the auroras. The study found the effective relative aperture of the camera as the function of the zenith distance. Possible displacements of the optical parts and the deviation do not greatly change the distortion curve, but result in the displacement of the zenith point on the pictures; this fact should be taken into consideration in the reduction of ascafilms. The problem of the optimal program of exposition and of the resolving power and limit of detection of the camera has been studied experimentally. The paper gives measurements of changes of exposure time, which were found to be negligibly small, and also of the deviations from given initial and final exposure times. Author

N64-32818 Saskatchewan U., Saskatoon (Canada) Inst. of Upper Atmospheric Physics
A MODEL OF A PHOTOELECTRIC SCANNING SYSTEM FOR AURORAL HEIGHT MEASUREMENTS IN REAL TIME
Radio Study
M. P. Wenkoff, G. G. Shepherd, and P. N. Nikiforuk May 1964 36 p refs
(Grant DRB-9511-25)
(RS-13)

The model system was constructed for measurement of heights of clouds in the daytime sky. Two scanning photometers were built, situated about a mile apart, and integrated into a closed system by using telephone lines. Both photometers were controlled from the main station (located at one of the photometers) using a dc servomechanism for remote control of one station. The relative phases of the scan cycles were given by pulses on an oscilloscope screen. The system gave parallactic angles with an estimated probable error of 5 min of an arc.
P.V.E.

N64-32852 Texas U., Austin Electrical Engineering Research Lab.
A SURVEY OF GEOMAGNETIC MICROPULSATION RESEARCH CONDUCTED IN CONNECTION WITH THE CO-OPERATIVE GEOMAGNETIC MICROPULSATION MEASUREMENT PROGRAM
H. W. Smith, comp. 15 May 1963 45 p
(Contract Nonr-375(14))
(Rept.-130; AD-419864)

At a conference on geomagnetic micropulsations held at the University of California on August 12–14, 1962, a committee was formed from representatives of the several research groups in attendance to conduct a survey to determine the desirability of a co-operative measurement program. The favorable response from this survey resulted in the formation of the Co-Operative Geomagnetic Micropulsation Measurement Program. This report contains a condensed summary of a survey form mailed to all research groups in the United States and Canada known to have an interest in geomagnetic micropulsations. Author

N64-32864 Defense Research Board, Ottawa (Canada)
RECENT VERTICAL MOVEMENTS ON THE FAR EASTERN SEA FLOORS
V. F. Kanayev Aug. 1964 7 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 3, no. 4, 1963 p 669–673
(T-407-R)

By information gathered on the morphology and morphometry of the earth's planation surfaces, recent tectonic movements of the earth's crust were studied. Recorded echo soundings from the edge depth and slope of the Far Eastern coastal seas and the northwest part of the Pacific Ocean were evaluated. A considerable difference in the edge depth and slope of the planation surfaces was found, and the presence of vertical movements in the earth's crust was established. G.G.

N64-32896* General Dynamics Corp., San Diego, Calif. General Atomic Div.
RESEARCH ON ELEMENTAL ABUNDANCES IN METEORITIC AND TERRESTRIAL MATTER Summary Progress Report, 1 Sep. 1963–31 Aug. 1964
R. A. Schmitt 31 Aug. 1964 13 p refs
(Contract NASw-843)
(NASA-CR-59018; GA-5594) OTS: $1.00 fs; $0.50 mf

Abundances of 14 rare-earth elements and of Y, Na, Sc, Cr, Mn, Fe, Co, and Cu were determined by the technique of instrumental neutron-activation analysis. Radioisotopes (2.56-hr to 5.3-yr half-lives) of these elements were generated in meteoritic stony matter by thermal-neutron activation and were measured by gamma-ray scintillation spectrometry. Zirconium abundance was determined by emission spectrographic techniques. A computer program (IBM-7044) was devised for calculating abundances, using the peak area method. R.L.K.

N64-33012 RAND Corp., Santa Monica, Calif.
MAIN GEOMAGNETIC FIELD
E. H. Vestine Sep. 1964 87 p refs Submitted for Publication
(P-2978)

The source of the magnetic field of the earth is discussed, and the history of magnetic-field measurements is given along with many old and current maps of the surface magnetic field. The secular variation is discussed at length, and various possible causes are suggested. The geomagnetic field in space is treated in terms of calculating the field, the length of field lines, L shells, charts of adiabatic invariants, and origin of the field. The effect of interplanetary fields on the main fields of the earth and the planets is described, and the estimated magnetic fields of planets and satellites are tabulated. D.E.W.

N64-33093* Pennsylvania State U., University Park Ionosphere Research Lab.
DRIFT EFFECTS ON PARAMETERS OF THE UPPER F-REGION UNDER DAYTIME EQUILIBRIUM CONDITIONS Scientific Report No. 221
H. Gregory Tornatore 1 Oct. 1964 66 p refs
(Grant NsG-134-61)
(NASA-CR-58941) OTS: $3.00 fs; $0.75 mf

A height-independent drift that represents the motion due to electrodynamic forces is inserted into the transport term of the continuity equation for atomic oxygen ions in the upper F-region. Solutions in the form of exponential series are obtained under daytime equilibrium conditions. The factors of diffusion, attenuation of solar radiation, and lack of temperature equilibrium between ions and electrons are included in the solution. Above the maximum the series converge very rapidly and are well approximated by the first few terms. In this way, simple solutions are developed that allow experimentally observed electron- or ion-density profiles to be related to the basic physical processes of production, loss, and transport of ionization. Modified solutions to include the effects of helium ions and hydrogen ions on the electron density profile are developed. Author

N64-33108 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
RATE OF GROWTH OR SHRINKAGE OF NONEQUILIBRIUM ICE SHEETS
J. Weertman Aug. 1964 21 p refs
(CRREL Res. Rept.-145; AD-449421)

An analysis is made of the time required to build up an ice-age ice sheet and of the time required to destroy such an ice sheet. The calculations are based on the approximation that the theory of perfect plasticity is valid. It is concluded that the time required to build up an ice-age ice sheet is longer than the time required to eliminate it. If it is assumed that the accumulation rate of an ice-age ice sheet lies in the range of 0.2 to 0.6 m/yr, it is found that the growth time of a large ice sheet is of the order of 15 000 to 30 000 yr. Ablation rates of 1 to 2 m/yr lead to shrinkage times of the order of 2000 to 4000 yr, provided ablation occurs over an appreciable area of the ice sheet. Author

N64-33155* Smithsonian Astrophysical Observatory, Cambridge, Mass.
GEOCHEMISTRY: TRITIUM RETENTION IN IRON METEORITES
David Tilles Repr. from Nature, v. 200, no. 4906, 9 Nov. 1963 p 563–564 refs
(Grant NsG-87-60)

Experimental meteorite evidence is summarized to refute a suggestion that tritium in iron may decay radioactively in a time much shorter than its 12-year half-life, perhaps with a half-life of several days or less. The author hypothesizes that tritium is retained in the taenite phase of meteorites and lost by diffusion from the kamacite phase. This would explain the low tritium value of the meteorite in Sikhote-Alin—a hexahedrite with practically no taenite, the low tritium values in the Sputnik IV steel fragment, and the variability of tritium concentration observed in octahedrite samples and in chondrites with variable taenite to kamacite ratios. R.L.K.

N64-33160* Lockheed Missiles and Space Co., Palo Alto, Calif.
CYCLOTRON EXCITATION OF HYDROMAGNETIC EMISSIONS Final Report, 16 Jan.–16 Apr. 1964
Lee Tepley et al [1964] 54 p refs *Its* Rept.-4-82-64-1
(Contract NAS5-3656)
(NASA-CR-59199) OTS: $3.00 fs; $0.50 mf

From a study of frequency–time characteristics of signals received at four widely separated low-latitude stations, the existence of a low-level sub-elf emission, which is almost always present during the nighttime hours, was ascertained. A brief analysis of amplitude–time hydromagnetic-emission data from Palo Alto and Kauai has demonstrated a pronounced ionospheric attenuation effect that verifies previous work on attenuation of hydromagnetic waves in the ionosphere. The theoretical maximum trapped-particle loading of field lines in the magnetosphere is derived. The result is utilized in the cyclotron excitation of hydromagnetic emissions. A new model is presented that explains a number of observed hydromagnetic-emission characteristics. Author

N64-33210* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
THE RED LINE OF ATOMIC OXYGEN IN THE DAY AIRGLOW
A. Dalgarno and James C. G. Walker (Queens U., Belfast) Jun. 1964 56 p refs Submitted for Publication
(Grant NsG-445)
(NASA-TM-X-54705) OTS: $2.00 fs; $0.50 mf

It is argued from the observations of the red line that the rate coefficient for deactivation of the excited oxygen atoms in collisions with molecular oxygen cannot be much less than $10^{-10}cm^3sec^{-1}$ and that the solar flux in the region of 1450 Å cannot be as large as the reported measured values. It is further argued that photodissociation of molelcular oxygen and recombination of molecular ions are inadequate to explain the observations and that an additional mechanism is operative at high altitudes. The mechanisms of fluorescent excitation and of nonthermal excitation by photoelectrons are briefly examined, and it is concluded that although the latter may be a significant source of excited atoms, neither mechanism explains the observed variability. It is suggested that the variability in red line intensities is associated with the presence of hot thermal electrons, and sample calculations are presented of the altitude profiles that may result from this source. Author

N64-33214* National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
ABSOLUTE PHOTOMETRY OF THE LIGHT OF THE NIGHT SKY—THE ZENITH INTENSITY OF HALEAKALA (LATITUDE N. 20.7°) AND AT FRITZ PEAK (LATITUDE N. 39.9°)
F. E. Roach and L. L. Smith 29 Jun. 1964 57 p refs
(NASA Order R-18)
(NASA-CR-59011; NBS-TN-214) OTS: $3.00 fs; $0.50 mf

A study is presented of 1 year of systematic zenith observations made with similar photometers at two observing stations: Haleakala (lat. 20.7° N) and Fritz Peak (lat. 39.9° N). It is shown that, for an effective wavelength of 5300 Å, there is a change of intensity with sidereal time (and therefore right ascension) due to three components: (1) integrated starlight, (2) zodiacal light, and (3) airglow continuum. Quantitative separation of the components is made. A critical comparison is made with some earlier investigations, with particular reference to the problem of the galactic light. Author

N64-33224* Hawaii Inst. of Geophysics, Honolulu
THE LIGHT OF THE NIGHT SKY: ASTRONOMICAL, INTERPLANETARY AND GEOPHYSICAL
F. E. Roach [1964] 61 p refs
(NASA Order R-18)
(NASA-CR-58994) OTS: $3.00 fs; $0.75 mf

This paper offers a resolution of the light of the night sky into the three basic components of integrated starlight, zodiac light, and airglow. A refined analysis of the gathered data gives a variation of the zodiacal light as a function of the differential ecliptic longitude between the zenith and the sun. The interrelationship of the constituents of the light of the night sky is analyzed by surface brightness and and distance or extent, and the extra galactic nebulae of the night sky are discussed. G.G.

N64-33256 Institut Royal Meteorologique de Belgique, Brussels
THE SECULAR VARIATION OF THE EARTH'S MAGNETIC FIELD IN BELGIUM, PERIOD 1955–1960 [LA VARIATION SECULAIRE DU CHAMP MAGNETIQUE TERRESTRE EN BELGIQUE, PERIODE 1955–1960]
A. De Vuyst 1964 13 p refs In FRENCH and FLEMISH *Its* Publ. Ser. A, No. 48

Transitory and long-term variations in the terrestrial magnetic field are discussed, and tables and charts giving the average annual values of the magnetic elements and the annual ratio of secular variation for 1955–1960 at Dourbes, Belgium, are presented. M.P.G.

N64-33267 Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDIES OF METASTABLE ATOMS AND MOLECULES USING BEAM TECHNIQUES Final Report
Nathaniel P. Carleton Aug. 1964 16 p refs
(Contract AF 19(628)-2949)
(AFCRL-64-698; AD-607056)

This report describes work on a laboratory study of certain atomic collision processes of interest in upper atmosphere physics, and on an analysis of certain phenomena of the aurora and airglow in terms of the collision processes involved. The major part of the laboratory work has been the study of excitation of metastable atoms and molecules by electron impact upon a thermal molecular beam, coupled with study of radiation from the molecules thus excited and from other molecules to which they may transfer energy in collision. Author

N64-33271 Kiruna Geophysical Observatory (Sweden)
A NEW METHOD FOR DETERMINING THE ALTITUDE OF SCINTILLATION-PRODUCING IRREGULARITIES Scientific Report No. 8
Ludwik Liszka 14 Jul. 1964 9 p refs
(Contract AF 61(052)-678)
(AFCRL-64-742; AD-606647)

A new method of measuring the height of the irregularities responsible for the scintillation phenomenon is proposed. The amplitude of a satellite signal will be recorded by a fixed receiver on the ground and by a receiver located on an aircraft moving in the same direction as the diffraction pattern. Comparison of the scintillation rates at the two receivers will give the height of the diffracting layer. Author

N64-33278* Michigan U., Ann Arbor Space Physics Research Lab.
IONOSPHERIC ELECTRON DENSITY AND BODY POTENTIAL MEASUREMENTS BY A CYLINDRICAL PROBE

Andrew F. Nagy and Ahmed Z. Farui Sep. 1964 34 p refs
(Contract NASr-54(04))
(NASA-CR-59158) OTS: $2.00 fs; $0.50 mf

Three data reduction techniques are used to obtain the electron density and the reference body potential from the experimental electron-current characteristics of a cylindrical probe. The results obtained by the different methods are compared and discussed. P.V.E.

N64-33308 St. Louis U., Mo.
THE BILLIKEN CALIBRATION SHOT IN SOUTHEAST MISSOURI Scientific Report No. 4
William Stauder, John Dowling, and Wayne H. Jackson Aug. 1964 31 p refs
(Contract AF 10(604)-7399; ARPA Order 292)
(AFCRL-64-659; AD-606573)

On June 28, 1963, a 20 000-lb high-explosive calibration-shot, code-named Billiken, was detonated near the epicenter of the magnitude 5, Southeast Missouri earthquake of March 3, 1963. Using arrival times at stations comparable to those used in locating the March 3 earthquake, the instrumental epicenter of Billiken was located within 2 to 4 km of the shot point. This confirms the accuracy of epicenter locations in this area from the data of near-regional stations. The shot has also permitted the "calibration" of the area, making possible epicenter locations using time differences of arrivals at pairs of stations. To the east, north, and west of the shot-point, travel times from Billiken agree with those of previous earthquake studies and of a current refractions survey; to the south, negative residuals were obtained. Author

N64-33309 AVCO Corp., Wilmington, Mass. Research and Avanced Development Div.
STUDY OF ATMOSPHERIC ELECTRIC TRACING OF HIGH-ALTITUDE IRREGULARITIES Final Report
H. Dolezalek 5 Oct. 1964 63 p refs
(Contract AF 19(628)-3289)
(AFCRL-64-678; AD-606874)

Atmospheric electric parameters measured at the ground or in the troposphere are frequently observed to be correlated with auroras or other cosmic or ionospheric events. Such correlations cannot be explained on the basis of our present knowledge of atmospheric electricity and auroral physics. Several qualitative hypotheses are presented. A new experimental approach is proposed that utilizes a high-flying aircraft suitably equipped with ionospheric instrumentation. The aircraft would tow a float containing atmospheric electric equipment. A general survey of measuring methods for small electric fields in the stratosphere is included. Author

N64-33365 Stanford Research Inst., Menlo Park, Calif.
COSMIC NOISE AND IONOSPHERE STUDIES—PROJECT VELA, PART I Final Report
R. B. Dyce, R. E. Winkelman, J. C. Hodges, G. L. Johnson, and B. C. Fair Dec. 1963 130 p refs
(Contract AF 49(638)-989; ARPA Order 159-60)
(AD-444659)

This report describes results of an experimental and theoretical study of the riometer and phase sounder for the detection of a nuclear burst in deep space. Particular attention is given to experimental studies of the natural ionospheric variations. Some equipment investigations were also carried out, and are described. Author

N64-33382* Consultants and Designers, Inc., Arlington, Va.
DETERMINATION OF SOME PARAMETERS OF THE EARTH'S ATMOSPHERE BY THE MOTION OF SATELLITES [OPREDELENIYE NEKOTORYKH PARAMETROV ZEMNOY ATMOSFERY PO DVIZHENIYU SPUTNIKOV]
A. M. Fominov 19 Oct. 1964 7 p refs Transl. into ENGLISH from Astron. Tsirkuliar Akad. Nauk SSSR (Kazan), no. 255, 3 Sep. 1963 p 1–6 Previously Announced as RAE-Trans-1059; see N64-23170 16-12
(Contract NAS5-3760)
(NASA-TT-F-8974; ST-AI-10223; RAE-Trans-1059) OTS: $1.00 fs; $0.50 mf

The parameters of a nonspherical terrestrial atmosphere are determined by applying the method of least squares to the variations of the 1958 Alpha, 1960 Xi, 1961 Nu, and 1959 Eta satellites' convolution periods. The following are considered in determining the parameters: (1) the long-period oscillations of orbits' perigee distances, caused by zonal harmonics of the earth's potential, through the use of conditional equations for the variations of the satellites' revolution periods; (2) the effect of solar activity on the variation of the atmosphere density; and (3) the effect of solar activity on air density. P.V.E.

N64-33384* Consultants and Designers, Inc., Arlington, Va.
MEASUREMENT OF THE IONOSPHERE TEMPERATURE BEGINNING WITH THE TWILIGHT FLUORESCENCE OF ALUMINUM OXIDE [MESURE DE LA TEMPERATURE DE L'IONOSPHERE A PARTIR DE LA FLUORESCENCE CREPUSCULAIRE DE MONOXYDE D'ALUMINIUM]
B. Authier, J. E. Blamont, and G. Carpentier 23 Oct. 1964 8 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 20, no. 9, Sep. 1964 p 342–345
(Contract NAS5-3760)
(NASA-TT-F-8977; ST-AI-10226) OTS: $1.00 fs; $0.50 mf

A tight emitter was manufactured containing a mixture of 7 kg of aluminum and 6 kg of sodium nitrate compressed at 25 kg/cm^2. The emitter, placed aboard a Centaur rocket and fired at a solar depression 6° 30', produced a visible sodium cloud at an altitude of 177 km. Temperature was measured by a monochromator and a two-way monochromator–photometer. The result was a precise measurement of the temperature at 177 km: $0 = 750° \pm 50°$ K. A.W.

N64-33386* Consultants and Designers, Inc., Arlington, Va.
OBSERVATIONS OF STRUCTURED HYDROMAGNETIC EMISSIONS AT CONJUGATE POINTS OF MIDDLE LATITUDES [OBSERVATIONS EN POINTS CONJUGES DE MOYENNES LATITUDES DES EMISSIONS HYDROMAGNETIQUES STRUCTUREES]
Valeriana A. Troitskaya, Roger Gendrin, and Robert Stefant 27 Oct. 1964 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Ionosphère (Paris), v. 259, 3 Aug. 1964 p 1175–1178
(Contract NAS5-3760)
(NASA-TT-F-8979; ST-AI-HMW-10229) OTS: $1.00 fs, $0.50 mf

The magnetic micropulsations in the frequency band of 0.1 to 5 cps were studied by analogous induction devices at conjugate points of the middle latitudes. The registrations were obtained by magnetic tape, filtered through a wideband filter in order to eliminate the slower pulsations, and then photographed on an oscilloscope with a camera. The periods of repetition were calculated on a sonogram, assuming a passing velocity constant over the whole duration of the phenomenon. It was found that the frequency of the hydromagnetic emissions does not increase with the latitude, contrary to earlier observations. G.G.

N64-33388* Consultants and Designers, Inc., Arlington, Va.
NOTE ON THE ALTITUDE DISTRIBUTION OF METEOR TRAILS [NOTE SUR LA DISTRIBUTION EN ALTITUDE DES TRAINEES METEORIQUES]
I. Revah and A. Spizzichino 2 Nov. 1964 11 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 20, no. 3, 1964 p 325–328
(Contract NAS5-3760)
(NASA-TT-F-8981; ST-IM-10227) OTS: $1.00 fs; $0.50 mf

The main studies in this paper are "Length of a Trail Projected on a Vertical"; "Altitude of the Central Point of a Trail"; "Comparison of Orders of Magnitude of L and of σ"; "Confrontation with Experiments"; and "Calculation of the Probability." G.G.

N64-33405* National Aeronautics and Space Administration, Washington, D.C.
APPROXIMATE SOLUTION OF THE RADIATIVE TRANSFER PROBLEM IN ANISOTROPIC SCATTERING [O PRIBLIZHENNOM RESHENII ZADACHI PERENOSA IZLUCHENIYA PRI ANIZOTROPNOM RASSEYANII]
O. Avaste Oct. 1964 13 p refs Transl. into ENGLISH from Issled. po Fiz. Atm., v. 3, 1962 p 72–83
(NASA-TT-F-9141) OTS: $1.00 fs; $0.50 mf

Questions concerning the precision of the Sobolev approximate method are discussed, and a possible correction of this problem is shown. New approximate formulas are given, and the errors are estimated comparing the fluxes of diffuse radiation with those calculated numerically by the method of successive approximation. The new formula for the diffuse radiation flux gives better results than the Sobolev formula in the case of a great optical thickness and anisotropic scattering (strong forward scattering). In the new formula the secondary scattering is defined, and its dependence upon the azimuth is taken into account, making use of three terms of the expansion of the scattering function into Legendre series. The scattering of the higher order using the spherical scattering function is noted. Author

N64-33437 Alaska U., College Geophysical Inst.
SPECTROPHOTOMETRY OF ATMOSPHERIC PHENOMENA AT HIGH ALTITUDES–VELA Final Report
Albert E. Belon et al Jul. 1964 65 p refs
(Contract AF 49(638)-1100; ARPA Order 159-61)
(WAG-R153; AD-444618)

The detailed analysis of low-brightness pulsating auroras, including power spectral analysis of the records, yields a peak amplitude for periods around 10 seconds for the particular cases studied. A technique of analyzing almucantar surveys at different elevation angles was used to increase the usable data obtained during any one twilight. This method of observing twilight resonance emissions made it possible to extend the sky coverage up to a 20 000-sq-km area. Preliminary experimental observations were obtained in the 7200 Å to 11 000 Å region with the available infrared instrumentation. These observations generally confirm the previously reported results that indicate great variability of the relative intensities as well as of the individual intensities of the various emissions. D.E.W.

N64-33480 Institut Royal Meteorologique de Belgique, Brussels
INVESTIGATION OF THE RELIABILITY OF RADIOSONDE MEASUREMENTS IN UCCLE WITH THE METHOD OF TWIN SONDES
A. G. Maenhout 1964 11 p refs *Its* Publ. Ser. B, No. 43

Results of a series of soundings using twin sondes to determine the repeatability of observations made at the Royal Belgian Meteorological Institute (Uccle) are reported. The twin sondes consisted of a Graw H 50 sonde with a 153-MHz transmitter coupled to an identical sonde with a 27-MHz transmitter. The sondes were chosen at random from a large supply calibrated at the Institute. The small dispersion of the results given for simultaneous measurements of pressure, temperature, and relative humidity indicates that the Graw sondes in use at the Institute may be considered as satisfactory. M.P.G.

N64-33484 Defence Research Board, Ottawa (Canada)
METEORITE CRATERS
I. A. Nekrasov and P. A. Raudonis May 1963 6 p refs Transl. into ENGLISH from Priroda (Moscow), no. 1, 1963 p 102–104
(T-385-R; AD-421404)

The circular shape of a depression and the presence of a fragmentation zone cannot be taken as decisive proof of meteoritic origin, particularly if the origin of the "crater" may be explained by other causes such as volcanic eruption or circular subsidences. The discovery of natural coesite in the Arizona meteorite crater, and subsequently in others, led to the idea that the conversion of quartz to coesite takes place only through the mighty explosion of a large meteoritic body when it strikes the earth, and that the presence of coesite can serve as a criterion for identifying other meteorite craters. The absence of coesite in eight samples selected from the rim of Lake El'gytkhyn shows that this depression is not a meteorite crater but a circular subsidence. Coesite appears to be a sensitive indicator, specific of meteorite craters alone, and not formed in zones of intense tectonic disturbance such as the circular sink of Lake El'gytkhyn. D.S.G.

N64-33490 Colorado U., Boulder
MODEL STUDY OF IONOSPHERE PERTURBATIONS AND PROPAGATION BETWEEN TWO SITES Quarterly Report, 1 Apr.–1 Jul. 1964
[1964] 3 p
(Contract NBS CST-7348; ARPA Order 183-62)
(QR-10; AD-444538)

The effects of wall perturbation in multimode waveguides have been studied. A correspondence between the phenomena in the waveguide and in the earth–ionosphere waveguide was established, and thus the waveguide is considered as a model of the earth's ionosphere waveguide. Various effective height profiles of the ionosphere were simulated in a model waveguide with finite impedance boundaries. The deflected energy was found to be much smaller than the forward scattered energy. Various means to obtain a dielectric material with uniformly increasing susceptibility have been considered, and a method of variation of the dielectric constant by different compression of a uniform slab of low-loss plastic foam was selected as the most promising. G.G.

N64-33554 Stanford U., Calif. Radioscience Lab.
WAVE PARTICLE GYRORESONANCE INTERACTIONS IN THE EARTH'S OUTER IONOSPHERE Technical Report No. 3412-5
T. F. Bell May 1964 206 p refs
(Contract AF 49(638)-1060; Grant AF-AFOSR-62-370)
(SU-SEL-64-063; AD-607379)

An investigation is presented of certain aspects of those gyroresonance interactions that take place between very-low-frequency electromagnetic waves and charged particle fluxes in the earth's outer ionosphere. These interactions, in which significant amounts of energy can be exchanged between the particle's kinetic energy form and the wave electromagnetic-energy form, are thought to be of importance with respect to the dynamical properties of the earth's outer ionosphere. Specifically, two problems are considered. The first problem

involves the stability of the outer ionosphere plasma to whistler-mode waves under conditions in which high-energy electron fluxes permeate this plasma. The second problem involves the feasibility of the creation or depletion of an artificial radiation belt utilizing the geocyclotron gyroresonance interaction in order to transfer energy between manmade waves and relativistic electrons trapped in the outer ionosphere by the earth's magnetic field near the magnetic equatorial plane. Author

N64-33558* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOME RESULTS OF ROCKET EXPERIMENTS IN THE QUIET D REGION
A. C. Aikin, J. A. Kane, and J. Troim Jun. 1964 23 p refs
(NASA-TM-X-55075; X-615-64-173) OTS: $1.00 fs; $0.50 mf

Two electron-density profiles have been obtained for the quiet day midlatitude D-region by means of ground-to-rocket radio-propagation experiments. These profiles are interpreted between 85 and 70 km in terms of solar Lyman-alpha ionization of nitric oxide. The role of 2 to 10 angstrom X-rays is shown to be unimportant to the formation of the D-region for the quiet solar conditions present during the two rocket flights. The electron collision frequency in the D-region is shown to be subject to significant variations, which are correlated to pressure variations of the stratosphere. Author

N64-33597 RAND Corp., Santa Monica, Calif.
SHORT REVIEW OF GEOMAGNETISM
E. H. Vestine Oct. 1964 94 p refs Submitted for Publication (P-2996)

Topics covered in this geomagnetism review include the following: (1) geomagnetic surface field—eccentric dipole, magnetic survey, and magnetic charts; (2) magnetic field in space—ionosphere and magnetosphere, calculated field-line configurations, and adiabatic invariants and L-shells; (3) fields and particles (morphology of the geomagnetic field)—solar influences on the outer geomagnetic field, disturbance daily variation and magnetic bays, solar daily magnetic variation and lunar daily variation, and relations of the disturbance field to other phenomena. M.P.G.

N64-33629* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPUTATION OF THE MAIN GEOMAGNETIC FIELD FROM SPHERICAL HARMONIC EXPANSIONS
Joseph C. Cain, Shirley Hendricks, Walter E. Daniels, and Duane C. Jensen Oct. 1964 46 p refs
(NASA-TM-X-55105; X-611-64-316) OTS $2.00 fs; $0.50 mf

The differences in the conventions used in various computer codes, written for the computation of the geomagnetic field, are pointed out, and a coherent set of computer programs (for computing the field) suitable to different uses is presented. Also presented are some sets of spherical harmonic coefficients (given in units of gamma) as obtained by the given programs. P.V.E.

N64-33630* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NIGHT-TIME MEASUREMENT OF OZONE ABOVE 40 KM
Edith I. Reed and Reuben Scolnik Sep. 1964 30 p refs
(NASA-TM-X-55101; X-613-64-267) OTS: $2.00 fs; $0.50 mf

The ozone distribution between 40 and 70 km was measured near midnight by means of photometers sensitive to the ultraviolet airglow at wavelengths between 2400 and 2900 Å. Below 60 km, the densities are within a factor of two of the daytime photochemical equilibrium. Above 60 km, the ozone density increased with altitude, with its maximum increase, a factor of 6 over the daytime value, occurring at 63 km. Author

N64-33637* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A RADIATION CLIMATOLOGY IN THE VISIBLE AND INFRARED FROM THE TIROS METEOROLOGICAL SATELLITES
W. R. Bandeen, M. Halev, and I. Strange Aug. 1964 56 p refs Presented at the Intern. Radiation Symp., Intern. Assoc. of Meteorology and Atmospheric Phys. (IUGG), Leningrad, Aug. 1964
(NASA-TM-X-55088; X-651-64-218) OTS: $3.00 fs; $0.50 mf

Measurements of reflected solar radiation have been acquired within filtered passbands of approximately 0.2μ to 6μ and 0.55μ to 0.75μ and, of emitted long-wave radiation, within passbands of approximately 8μ to 12μ, 8μ to 30μ, 6μ to 6.5μ, and 14.8μ to 15.5μ. A limited climatology of the spatial and temporal variations of the total outgoing long-wave radiation and of the planetary albedo is derived from the beam measurements within the 5° field of view of a five-channel scanning radiometer. The results show essential agreement with previous studies of the planetary heat balance, based upon conventional data. In addition to the heat balance results, the relative planetary distribution of atmospheric moisture is inferred from measurements made within the 6.3μ band of water vapor, and the seasonal changes of mean temperatures in the stratosphere between about 15 and 35 km are shown from measurements made within the 15μ band of carbon dioxide. Author

N64-33654* Georgia Inst. of Tech., Atlanta
EVENING TWILIGHT WINDS FROM 68 TO 140 KILOMETERS FOR MAY 21, 1963
H. D. Edwards, C. G. Justus, and D. C. Kurts Repr. from J. Geophys. Res., v. 68, no. 21, 1 Nov. 1963 p 6062–6063 refs
(Grant NsG-304; Contract AF 19(628)-393)

Sodium-vapor-trail triangulation techniques were used to measure wind patterns as a function of altitude from 68 to 140 km. High wind shears were observed, and a high degree of instability occurred along much of the trail. Between 109 and 110 km, a shear of 56 m/sec km existed in the east–west component of wind velocity. The north–south and east–west components exhibited a sinusoidal-like pattern, with both wavelength and amplitude increasing with altitude. The 90- to 105-km portion of the trail was broken tnto a globular structure, and the appearance of the trail from 69 to 90 km suggested a turbulent condition in this region. M.P.G.

N64-33688* Georgia Inst. of Tech.,,Atlanta
IONOSPHERIC WINDS: MOTIONS INTO NIGHT AND SPORADIC *E* CORRELATIONS
N. W. Rosenberg (AFCRL), H. D. Edwards, and J. W. Wright (NBS, Boulder, Colo.) Repr. from Space Res. IV, N. Holland Publ. Co., 1963 13 p refs
(Grant NsG-304-63; Contracts AF 19(604)-5467; AF 19(628)-393)
(NASA-CR-59013) OTS: $1.00 fs; $0.50 mf

The persistence of night winds and shears for more than five hours after sunset at altitudes between 100 and 150 km was evaluated during the COSPAR synoptic ionospheric winds program in December 1962. The method used was to release chemiluminous trails from rockets between 100 and 150 km with the times of release being 1720, 1801, 2145, and 2245 CST on 3 December 1962. The release times were respectively

13 minutes before sunset at the 100-km level and 28 minutes, 4 hours 12 minutes, and 5 hours 12 minutes after sunset. All rockets were launched at a longitude of 86.6° W and a latitude of 29.6° N. The paper reports on simultaneous measurements of ionospheric wind shears (measured by chemiluminescent trails) and of sporadic-*E* (by sweep-frequency ionosondes). Occurrence at the same altitudes of maximum wind shears and strong sporadic-*E* levels was found. Author

N64-33724 Naval Ordnance Test Station, China Lake, Calif.
THE TERRESTRIAL NIGHT HORIZON AND SKY. 4.3 MICRON RADIANCE DATA GENERATED BY THE HITABTRIS EXPERIMENTS
George A. Wilkins and John A. Hoyem Jun. 1964 21 p refs Sponsored by ARPA
(Projs. Defender; Tris)
(NAVWEPS-8552; NOTS-TP-3578; AD-446436)

Data on the infrared spectral radiance of the night horizon and sky are presented. The data, accumulated by sounding rockets, show that the 4.3μ night sky is measurably bright at altitudes up to 50 km. Definite horizon limb brightening at this wavelength of strong carbon dioxide emission—absorption was observed. A peak limb spectral radiance of 3.2×10^{-5} W/cm^2/sterad/μ at 4.3μ was measured. An analogy between the emitting atmospheric carbon dioxide and a thick-shelled surface of radiation is drawn; it is verified by both the experimental data and by theory. Author

N64-33737 Weapons Research Establishment (Australia)
IONOSPHERIC DATA FOR DECEMBER 1963 FROM SALISBURY, SOUTH AUSTRALIA Ionospheric Data Bulletin
May 1964 26 p
(CPD-1963/12/S)

Hourly values of ionospheric data obtained at Salisbury, South Australia, are tabulated for December 1963. The characteristics of the ionosonde used are also given. M.P.G.

N64-33778* Smithsonian Astrophysical Observatory, Cambridge, Mass.
OPTICAL SATELLITE TRACKING PROGRAM Semiannual Progress Report No. 9, 1 Jul.–31 Dec. 1963
Fred L. Whipple [1964] 31 p
(Grant NsG-87-60)
(NASA-CR-56245) OTS: $2.00 fs; $0.50 mf

Activities and results are reported for the observatory in three major areas—data acquisition, data processing, and data utilization. Station operations, Moonwatch observations of satellites, and new communications services and equipment are described briefly; operations of the data division, of the photoreduction division, and of the computations division are discussed; and results from research and analysis and from certain special projects are presented. D.E.W.

N64-33808* State U. of Iowa, Iowa City
REMARKS ON ACCOMPANYING LETTER BY K. I. GRINGAUZ
James A. Van Allen Repr. from J. Geophys. Res., v. 69, no. 5, 1 Mar. 1964 p 1011–1013 refs
(Contract NASw-17; Grant NsG-233-62)

Comments are made on some papers by the Soviet scientist Gringauz, stating that he has not recognized the sun–earth-probe angle as an essential parameter in interpreting phenomena of the outer magnetosphere, that he regarded the outermost belt of charged particles as being trapped in the geomagnetic field, and that he disregarded Injun I and Injun III observations in claiming uniqueness for the series of Mars I observations of the high-latitude edge of the trapping region near the earth. D.E.W.

N64-33842 Geophysics Corp. of America, Bedford, Mass.
METEOROLOGICAL PREDICTION TECHNIQUES AND DATA SYSTEM Final Report
H. E. Cramer, G. M. de Santo, R. K. Dumbauld, P. Morgenstern, and R. N. Swanson 10 Mar. 1964 269 p refs
(Contract DA-42-007-CML-552)
(GCA-TR-64-3-6; AD-444197)

This report describes the development of a generalized diffusion model for use in predicting dosage fields associated with the release of CB agents or tracers. The adaptation of this model to quasi-instantaneous volume sources located near ground level as well as the evaluation of the performance of the model, based on a rigorous statistical comparison of the values of five dosage parameters predicted by the model with those observed during previous field trials of bomblet-type CB munitions, was made. The generalized model that is adjustable for source function time and source dimensions demonstrates the feasibility of separating source parameters from meteorological and terrain factors. The significance of this conclusion, with respect to the development, testing, and tactical use of CB weapons, is discussed. Author

N64-33958 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE WORLD OF THE OCEAN
V. N. Stepanov 21 Oct. 1964 12 p refs Transl. into ENGLISH from Geofiz. Byul. (Moscow), no. 4, 1963 p 29–33
(JPRS-26999; TT-64-51255)

This paper contains plans from the United States and the Soviet Union for systematic, synoptic surveys, and general reconnaissance studies of the oceans. The installation of multiple-serial hydrometeorological stations at specific points is discussed in order to carry out the complex oceanographic surveys and the evaluation of the gathered data. G.G.

N64-33984 Weapons Research Establishment (Australia) Dept. of Supply
IONOSPHERIC DATA FOR NOVEMBER, 1963 FROM WOOMERA, SOUTH AUSTRALIA
Apr. 1964 24 p
(CPD-1963/11(W))

Tables are presented of hourly and daily values of 10 different ionospheric characteristics for November 1963, as measured by ionosonde at Woomera. Characteristics measured include f_b E_s, f_0 E_s, f_0 E, f_0 F_1, f_0 F_2, f_{min}, h' E_s, h' E, h' F, and h' F_2. D.E.W.

N64-34013* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ON THE HEIGHT OF AURORAL ABSORPTION, I
Bengt Hultquist Repr. from Planet. Space Sci., v. 12, no. 8, 1964 p 579–589 refs
(NASA-RP-359)

The height distribution of the absorption produced by two different observed electron spectra, $N(E)dE = 5.10^9 \exp(-E/5)dE$ and $N(E)dE = 7.10^4 \exp(-E/41)dE$ and also by the bremsstrahlung from the first-mentioned one has been estimated. The results indicate that the absorption in the 60- to 90-km range, due to hard electron spectra, often may dominate, whereas the absorption caused by bremsstrahlung is smaller than that due to the primary electrons producing the X-rays. These results are discussed in respect to the height of the absorbing layer and the observed small variation of auroral absorption at sunrise and sunset. Author

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-32695 ARDE-Portland, Inc., Paramus, N.J.
MATERIALS AND COOLANT SYSTEMS FOR SOLID PROPELLANT ROCKET NOZZLES
Philip Wachs *In* Army Mater. Res. Agency Proc. of the Rocket Nozzle Mater. Symp. Dec. 1963 p 29–56 refs (See N64-32692 24-17)
(Contract DA-30-069-ORD-3099)

The operating mechanisms, advantages, disadvantages, and associated problems of various coolant systems for solid-propellant rocket nozzles are reviewed and discussed. Specific systems reviewed are transpiration cooling, pool boiling, and forced convection. Of these, forced convection and spray film cooling are being experimentally investigated using liquid lithium metal as the coolant. The experimental facilities (including instrumentation) for studying each of these two cooling systems are described. The advantages of using liquid lithium as a coolant in a hybrid rocket engine are also presented. Author

N64-32809 Little (Arthur D.) Inc., Cambridge, Mass.
STUDY OF HIGH TEMPERATURE THERMODYNAMICS OF LIGHT METAL COMPOUNDS Progress Report No. 10, 1 Apr.–30 Jun. 1964
Alfred Büchler 30 Jun 1964 6 p refs
(Contract DA-19-020-ORD-5584; ARPA Order 40-62)
(C-64362; AD-443458)

In electric deflection experiments lithium iodide was shown to have a planar structure. Barium iodide was examined in the hope that a parent ion might be found; in fact, BaI_2^+ was observed and was found to refocus, thus confirming the bent structure of BaI_2. Cadmium and mercuric fluorides were found to be nonpolar and hence linear. The electric deflection method was applied to the determination of the electronic ground state of diatomic molecules. The experiments were comparative; the amount of refocusing of the molecules whose ground state was to be determined was compared to the amount of refocusing of a molecule of known gound state, the moments of inertia of the two molecules and the temperatures of the two experiments being as similar as possible. Application of the method confirmed the spectroscopic assignment of the ground state of lanthanum oxide as $^4\Sigma$. Mass-spectrometric examination of sodium and lithium nitrate and nitrite evaporation is also reported. R.L.K.

N64-32882 Lockheed Missiles and Space Co., Palo Alto Aerospace Science Lab.
STRATIFIED LAYER FLOW MODEL: A NUMERICAL APPROACH TO TEMPERATURE STRATIFICATION IN LIQUIDS CONTAINED IN HEATED VESSELS
Gary C. Vliet Nov. 1963 78 p refs

A stratification model "Stratified Layer Flow Model" and its accompanying numerical machine program are presented. The proposed model is based on a turbulent natural convection boundary layer that flows upward along the heated vessel walls to the liquid surface. The boundary layer continuously supplies liquid to the surface and simultaneously exchanges mass and energy with the previously stratified liquid as it passes through it. Mass and energy transfers occur at the surface between the liquid and ullage. Additionally, the liquid may be drained while being subjected to nuclear heating. Negative temperature gradients in the bulk liquid (in the upward direction) caused by nuclear heating result in a statically unstable condition, and by turbulent mixing these gradients tend to be eliminated. Due to the complexity of the above process, the model is treated numerically in discrete time-steps by an IBM 7094 machine program.. Author

N64-32994* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A METHOD FOR THE DETERMINATION OF LOCAL HEAT FLUX FROM TRANSIENT TEMPERATURE MEASUREMENTS
Walter B. Powell and Theodore W. Price Repr. from ISA Trans., v. 3, no. 3, Jul. 1964 p 246–254 refs Presented at the 18th Ann. ISA Conf. and Exhibit, Chicago, 9–12 Sep. 1963
(Contract NAS7-100)
(NASA-CR-59208; JPL-TR-32-578) OTS: $1.00 fs; $0.50 mf

This paper describes a method of determining the transient heat flux to the plane or cylindrical surface of an isotropic material. The method is applicable when the material is initially at a known temperature without heat transfer, and then is suddenly subjected to heat transfer at one surface. Temperature measurements made on or near the heat-transfer surface are used as boundary conditions for numerical solution of the transient-heat-conduction equation, enabling the temperature distribution within the material to be determined. The properties of the material may vary with temperature. Heat flux is computed as the product of the temperature gradient and the thermal conductivity at the surface. Experimental results from rocket motor testing indicate that the method can be used to determine local heat flux in combustion chambers and nozzles where the heat flux is known to vary in both circumferential and axial directions. Author

N64-33001 Kaman Aircraft Corp., Colorado Springs, Colo. Kaman Nuclear Div.
RADIATIVE HYDRODYNAMICS AND HEAT TRANSFER AS RELATED TO RE-ENTRY VEHICLES
John R. Hoffman et al 15 Jul. 1964 58 p refs
(ARPA SD-135; ARPA Order 343-62)
(KN-684-64-12; AD-444092)

This report covers the following analytical studies: (1) the ideal gas determined in terms of real physical distances rather than as functions of optical-path lengths; and (2) the total heat transfer attached to a rocket vehicle that is traversing a highly radiative media. G.G.

N64-33037* Connecticut U., Storrs. School of Engineering
HEAT TRANSFER STUDIES OF VAPOR CONDENSING AT HIGH VELOCITIES IN STRAIGHT TUBES Interim Progress Report, 1 Nov. 1963–30 Apr. 1964
C. H. Coogan, Jr., W. E. Hilding, W. Davis, M. J. Casarella, F. L. Robson et al 1 May 1964 17 p
(Grant NsG-204)
(NASA-CR-58838) OTS: $1.00 fs; $0.50 mf

This is a description of a long, small-diameter-tube heat exchanger, with an inner tube carrying the steam and the outer tube forming the cooling water annulus. By reversal of the cooling-water flow direction, the test section can be operated in either a parallel or counter-flow pattern. From a static pressure tap, and radially traversing total pressure and total temperature probes, the flow rate of the steam was computed and compared to that found by weighing the condensate. The data obtained from the test apparatus will be used as input

for a data-reduction program. A computer subroutine was developed to determine enthalpy, entropy, and specific volume as a function of pressure and temperature for the differently saturated steam regions. G.G.

N64-33079* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

THE NATURE OF LIQUID FILM EVAPORATION DURING NUCLEATE BOILING

Robert R. Sharp Washington, NASA, Oct. 1964 31 p refs
(NASA-TN-D-1997) OTS: $0.75

An evaporating liquid film formed at the base of bubbles during nucleate boiling was observed by two optical techniques. Interference of monochromatic light and reflection of polarized light yield film thickness against radius and time, local evaporative heat flux, and allow determination of wet and dry surfaces. The effects of different system parameters on bubble release, the evaporation process, and the boiling curve are discussed in relation to the experimental results. Author

N64-33081* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

HEAT TRANSFER FOR LAMINAR SLIP FLOW OF A RAREFIED GAS IN A PARALLEL-PLATE CHANNEL OR A CIRCULAR TUBE WITH UNIFORM WALL TEMPERATURE

Robert M. Inman Washington, NASA, Nov. 1964 41 p refs
(NASA-TN-D-2213) OTS: $1.00

An analysis has been made to determine the effects of low-density phenomena on the heat-transfer characteristics for laminar flow in a parallel-plate channel or in a circular tube with uniform wall temperature. Consideration is given to the slip-flow regime wherein the major rarefaction effects are displayed as velocity and temperature jumps at the conduit walls. The results apply along the entire length of the conduit. The solutions contain a series expansion, and analytical expressions for the complete set of eigenvalues and eigenfunctions for the problems are presented. The results give the temperature of the gas adjacent to the wall, the wall heat flux, and the Nusselt numbers for the conduits for various values of the rarefaction parameters. Author

N64-33083* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

AN INSTABILITY EFFECT ON TWO-PHASE HEAT TRANSFER FOR SUBCOOLED WATER FLOWING UNDER CONDITIONS OF ZERO GRAVITY

S. Stephen Papell Washington, NASA, Nov. 1964 14 p refs
(NASA-TN-D-2259) OTS: $0.50

Subcritical, subcooled boiling heat-transfer data were obtained for distilled water flowing through a resistance-heated tube in a gravity-free environment lasting approximately 15 seconds. Two types of flow models were found to exist under identical test conditions. An instability initiated by a momentary interruption of flow forced the transition from a highly subcooled bubbly flow to a postulated slug flow that resulted in a 16% increase in local heat-transfer coefficients. The slug-flow regime was described as consisting of two phases in a highly nonequilibrium thermodynamic state. A duplication of test conditions that produced the transition in a zero-gravity environment failed to do so under earth-gravity conditions. Author

N64-33111 Battelle Memorial Inst., Columbus, Ohio

METHODS FOR DISPOSING OF EXCESS SHELTER HEAT

John D. Hummell, David E. Bearint, and Lawrence J. Flanigan Aug. 1964 231 p refs
(Contract OCD-05-62-191)
((AD-446445)

The study of methods of disposing of excess shelter heat involved the technical and economic consideration of heat sinks, miscellaneous cooling-system components, and refrigeration devices. A comparison is made of the advantages, disadvantages, and estimated cost associated with various conventional and novel systems. Five major areas are discussed: (1) "Nuclear Radiation Effects"; (2) "Standby Maintenance Requirements"; (3) "Heat Sinks"; (4) "Cooling System Components"; and (5) "Refrigeration and Dehumidification Devices." In the section covering heat sinks, thermodynamic data, physical properties, and estimated costs for a variety of materials are considered. The last two sections present details covering the operation, reliability, and economics of a wide variety of equipment. Unconventional, as well as conventional, devices are described. A novel engine that could drive all components of a cooling system and would have no oxygen requirement is described. P.V.E.

N64-33114 ARO, Inc., Arnold Air Force Station, Tenn.

INTERPOLATIONS OF IMPERFECT NITROGEN THERMODYNAMIC DATA. I: AT CONSTANT ENTROPY

C. A. Neel and Clark H. Lewis Arnold Eng. Develop. Center, Oct. 1964 384 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-212; AD-449409)

The recent nitrogen thermodynamic data of Hilsenrath and Klein, the data of Smith including only second virial corrections as presented by Lewis and Neel, and the previous low-temperature data of Little and Neel have been interpolated at constant entropy over the ranges T = 200(100)15, 000° K and S/R = 13. 0(0.2)50. 50(1)133. Speed of sound data computed by Lewis and Neel are also included. Author

N64-33143 Canadian Armament Research and Development Establishment, Valcartier

ABLATION FROM LEXAN SPHERES AND CONES AT MACH 15

D. Heckman Sep. 1964 53 p refs
(ARPA Order 133)
(CARDE-TR-511/64)

The relationships between mass-transfer rate and heat-transfer rate derived from analyses of the boundary layer are reviewed, and a procedure for calculating the total amount of material ablated from around a body composed of subliming material is justified. Calculations are made of the amount of material ablated from lexan spheres and cones fired in the range atmosphere at Mach 15, based on a measured value of the heat of ablation of lexan. Author

N64-33174* National Bureau of Standards, Boulder, Colo.

VAPORIZATION OF THERMIONIC REFRACTORY MATERIALS Eleventh Status Report, 1 Mar.–31 May 1964

R. Szwarc, E. R. Plante, and J. J. Diamond 31 May 1964 12 p refs
(NASA Order R-57)
(NASA-CR-58774; NBS-8508) OTS: $1.00 fs; $0.50 mf

A comparison is made of the data of Langmuir and Zwikker in this study on the vaporization rate of tungsten. Measurements of the vaporization rate of an oriented single-crystal tungsten specimen were obtained, and it was concluded that if a difference between the vaporization rate of polycrystalline

tungsten and single-crystal oriented tungsten exists, this difference must be the same magnitude or smaller than the experimental errors involved in the measurements. E.C.

N64-33219* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
HEAT-TRANSFER TESTS OF THE BOEING SHOCK-WAVE IMPINGEMENT MODELS IN THE JPL 21-INCH HYPERSONIC WIND TUNNEL
John J. Minich 3 May 1964 11 p refs
(Contract NAS7-100)
(NASA-CR-58836; JPL-WT-21-155) OTS: $1.00 fs; $0.50 mf

A cone-fin model and a wedge-fin model, in various combinations of shock generators, thermocouple and pressure-instrumented fins, and several ceramic-covered stainless-steel fins, underwent testing in a wind tunnel to determine heating rates and pressure distributions on the vertical fin from a shock wave generated by the cone or wedge. The ratio of temperature change to time in the inner side of the thin-walled model was determined, the heat-transfer coefficient was defined, and was reduced to local heating rates. G.G.

N64-33262 Itek Corp., Palo Alto, Calif. Vidya Div.
A RE-EVALUATION OF HEAT-TRANSFER DATA OBTAINED IN FLIGHT TESTS OF HEAT-SINK SHIELDED RE-ENTRY VEHICLES
J. D. Murphy and M. W. Rubesin [1964] 35 p refs Presented at the Heating Session of the AIAA Entry Technol. Conf., Williamsburg/Hampton, Va. 13–15 Oct. 1964 *Its* paper-27

Experimental surface-heating rates inferred from thermocouple data obtained from two flights of the Air Force Mark 2 Reentry Vehicle were compared with theoretical predictions. The effects of a data smoothing technique, of variable thermal properties, and of axisymmetric conduction were considered in the determination of experimental heating. A direct solution was developed for the inviscid flow over very blunt bodies having sonic corners. Tentative conclusions are that stagnation-point heating is adequately predicted by the theory of Fay and Riddell, using the transport properties of Peng and Pindroh, and that the distribution of heating from a laminar boundary layer is adequately predicted by the theory of Kemp, Rose, and Detra. D.E.W.

N64-33318 Polytechnic Inst. of Brooklyn, N.Y.
AN ANNOTATED BIBLIOGRAPHY ON ABLATION AND RELATED TOPICS
Martin H. Israel and S. V. Nardo May 1964 158 p refs
(Contract Nonr-839(23))
(PIBAL-686; AD-603139)

This 700-entry bibliography was compiled with the objective of being as complete as possible, containing most, if not all, of the major works, as well as many of the less important works dealing with high-temperature environment, reentry dynamics and thermodynamics, cooling methods, ablation cooling, and materials for high-temperature applications. The classified references, however, are only a sample of the large number of works dealing with specific applications of ablative shielding and are meant to serve as a foundation for a further literature search. R.L.K.

N64-33326* National Bureau of Standards, Boulder, Colo.
VAPORIZATION OF THERMIONIC REFRACTORY MATERIALS Twelfth Status Report, 1 Jun.–1 Aug. 1964
R. Szwarc, E. R. Plante, and J. J. Diamond 31 Aug. 1964 8 p refs
(NASA Order R-57)
(NASA-CR-59273; NBS-8556) OTS: $8.00 fs; $0.50 mf

The data from studies by Sherwood, Langmuir, Stull, and Sinke concerning the rate of sublimation of rhenium are discussed briefly. The results of a semiquantitative spectrochemical analysis of Rhenium are listed, and the data indicate that no contaminant of any consequence is present in the material supplied. E.C.

N64-33421 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
RESULTS OF EXPERIMENTAL INVESTIGATION OF CONTACT HEAT EXCHANGE BETWEEN FLAT METAL SURFACES
V. S. Miller 21 Sep. 1964 19 p refs Transl. into ENGLISH from Teploobmin Ta Hidrodynamika, Akad. Nauk UkR. RSL (Kiev), no. 20, 1960 p 44–53
(RSIC-272; AD-606779)

Changes in the magnitude of thermal resistance between flat metal surfaces were studied as a function of pressure and surface properties for metals with different coefficients of heat conductivity. The metals studied included steels, bronze, aluminum, and copper. The experimental results indicated the following: (1) The pressure at the contact surfaces had a considerable effect on the magnitude of thermal resistance, particularly in the low-pressure range. (2) Large microscopic irregularities of the surface have a noticeable effect. (3) The magnitude of thermal resistance depends on the physical and mechanical properties of the metals. (4) The heat conductivity of the medium surrounding the contact zone affects the magnitude of thermal resistance. D.S.G.

N64-33423 Midwest Research Inst., Kansas City, Mo.
MASS SPECTROMETER STUDY OF METAL-CONTAINING FLAMES Quarterly Technical Summary Report, 1 Apr.–30 Jun. 1964
Thomas A. Milne and Frank T. Greene 10 Aug. 1964 13 p refs
(Contract Nonr-3599(00); ARPA Order 23-63)
(QTSR-11; AD-444105)

The aerodynamic molecular beam sampling system has been used successfully to sample stable products from several $CO–O_2$ flames. Oxygen-free radicals have also been quantitatively sampled. Evidence is presented for a strong temperature dependence of the cracking patterns of the simple molecules HCl and CO_2. Author

N64-33551 Martin Co., Orlando, Fla. Aerosciences Research Lab.
THERMAL RESPONSE IN SANDWICH PANELS Final Report, Dec. 1963–Jul. 1964
P. Kendall Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 140 p refs
(Contract AF 33(657)-8649)
(OR-6037; FDL-TDR-64-135; AD-607088)

An analytical model is presented for predicting thermal response in honeycomb sandwich panels. The model considers a variety of configurations involving single or stacked panels. Consideration is given to all three modes of heat transfer and to temperature dependent thermophysical properties of the materials of fabrication. The heat-balance equations are of the finite difference form and employ the forward difference technique for solution. A stability criterion is presented for the heat-balance equations. The entire system of equations is programed for solution on the IBM 7094 digital computer.

Validity of a portion of the analytical model is established by comparing predicted results to existing experimental data for single honeycomb panels. Author

N64-33574 Boeing Co., Seattle, Wash.
TURBULENT REFERENCE, ROUGHNESS, LEAKAGE AND DEFLECTED-SURFACE HEAT TRANSFER AND PRESSURE TESTS FOR TBC, MODEL X-20A
R. K. Ellison (Cornell Aeron. Lab.) 18 Jun. 1962 370 p refs
Prepared by Cornell Aeron. Lab. for Boeing Co.
(Contract AF 33(657)-7132)
(D2-80910; CAL-AA-1661-Y-1; AD-406248)

This report contains a summary of hypersonic shock tunnel tests on a blunt, leading-edge model with sweep angles of 55°, 60°, and 65°; on a hemisphere–cylinder model; and on a sharp flat plate with deflectable near-flap and span extension. The turbulent heat transfer and pressure rates were observed by thin-film resistance gage, and the pressure gradients on roughness and leakage effects with laminar and turbular boundary layer flow were determined by dual-element transducers. The outputs from all instrumentation were displayed on an oscilloscope and recorded on film. The variations in heat transfer, pressure distribution, and region of separation for aerodynamic control surfaces were defined, and model attitudes for the pressure variation and heat-transfer-rate distribution were determined. G.G.

N64-33589 Massachusetts Inst. of Tech., Cambridge
FILM BOILING OF SATURATED LIQUID FLOWING UPWARD THROUGH A HEATED TUBE: HIGH VAPOR QUALITY RANGE
William F. Laverty and Warren M. Rohsenow Sep. 1964 107 p refs
(NSF GP-1245)
(TR-9857-32)

Film boiling of saturated liquid flowing upward through a uniformly heated tube has been studied for the case in which pure saturated liquid enters the tube and nearly saturated vapor is discharged. This investigation has been concentrated on film boiling in the region where the vapor quality is greater than 10%. Visual studies of film boiling of liquid nitrogen flowing through an electrically conducting pyrex tube have been made to determine the characteristics of the two-phase flow regimes that occur as a result of the film boiling process. It was found that the annular flow regime with liquid in the core and vapor between the liquid and the tube wall, which exists at very low qualities, is broken up at higher qualities to form a dispersed flow of droplets and filaments of liquid carried along in a vapor matrix. Author

N64-33601* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL PERFORMANCE AND RADIO-FREQUENCY TRANSMISSIVITY OF SEVERAL ABLATION MATERIALS
Marvin B. Dow, Claud M. Pittman, and William F. Croswell Washington, NASA, Nov. 1964 39 p refs
(NASA-TN-D-1896) OTS: $1.00

An investigation was made of the thermal performance of ablation materials and of the attenuation of radio signals by degraded ablation materials. Nine cone-shaped models, consisting of a truncated magnesium-alloy shell and a contoured plastic nose cap with various heat-shielding materials bonded to the magnesium shell, were tested in the 2500-kW arc jet. Temperature measurements at several locations on the interior of the magnesium shells and measurements of radiofrequency attenuation due to thermal degradation of the protective materials were made. The relative thermal effectiveness of each material in the arc-jet environment was calculated from data obtained during testing. Author

N64-33701 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS OF SCHOOLS OF HIGHER EDUCATION. MACHINE BUILDING Selected Articles
6 Apr. 1964 30 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 1, 1963 p 97–116
(FTD-MT-63-203; AD-605887)

CONTENTS:

1. ON THE CALCULATION OF AIR COOLING OF A NOZZLE BLADE V. L. Ivanov p 1–14 refs
2. CERTAIN FEATURES OF CALCULATION AND DESIGN OF AXIAL COMPRESSORS AT SMALL REYNOLDS NUMBERS V. S. Beknev p 15–26 refs

N64-33747* National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
THE CORRELATION OF THERMODYNAMIC PROPERTIES OF CRYOGENIC FLUIDS
R. B. Stewart and K. D. Timmerhaus Repr. from Advan. in Cryog. Eng., Vol. 9, Proc. of the Cryog. Eng. Conf., Colo U., Boulder, 19–21 Aug. 1963
(NASA Order R-45)

The purpose of this paper is primarily to review the continuing program being carried out in the Cryogenic Data Center, to discuss the availability of cryogenic data for several of the cryogenic fluids, and to describe the evaluation and compilation programs that are being pursued to produce new property tables for these fluids. In describing the results of these compilation efforts, methods for utilizing the computer for thermodynamic data analysis are also suggested. Author

N64-33777* Pennsylvania U., Philadelphia Towne School of Civil and Mechanical Engineering
THE BINARY EUTECTIC AS A THERMAL ENERGY STORAGE SYSTEM: EQUILIBRIUM PROPERTIES
G. R. Belton and Y. Krishna Rao [1963] 22 p Presented at the 6th Natl. ASME-AIChE Heat Transfer Conf., Boston, Aug. 1963
(Grant NsG-316)
(NASA-CR-51748) OTS: $1.00 fs; $0.50 mf

The method is reviewed for the calculation of heats of fusion of binary eutectic systems of metals or salts from the available thermodynamic data. A preliminary survey has been made to find metals, metallic compounds, and binary systems of these substances that could serve as constant-temperature heat reservoirs for thermal energy storage. Author

N64-33821 Canadian Armament Research and Development Establishment, Valcartier
AN IBM 1620 PROGRAM FOR SOLUTION OF THE HEAT CONDUCTION EQUATIONS IN THE NOSE OF A PROJECTILE
Roland Tremblay Feb. 1964 23 p refs
(CARDE-TN-1593/64)

A FORTRAN program is presented for solving the equations of one-dimensional heat conduction through a semi-infinite slab with variable heat flux. This program has application to the problem of heat conduction in the nose of a blunt hypersonic projectile. Author

N64-33833 Martin Co., Denver, Colo. Aerospace Div.
PIECE-WISE AFFINE INTEGRAL SOLUTION FOR HEAT CONDUCTION IN AN ABLATING SLAB WITH MIXED TIME-DEPENDENT BOUNDARY CONDITIONS
Wayne E. Simon Jan. 1963 57 p refs
(R-62-26)

A piecewise affine integral solution has been developed for heat transfer in an ablating slab with mixed time-dependent boundary conditions. An algebraic approximation to a four-space of affine solutions has been found that reduces the general problem to the numerical solution of a first-order nonlinear differential equation. Further simplification is exhibited for certain special cases. Author

N64-33838 General Electric Co., Philadelphia, Pa. Missile and Space Vehicle Dept.
LOW DENSITY EFFECTS ON HEAT TRANSFER IN HYPERSONIC FLIGHT
Martin Kaplan [1961] 56 p refs
(Contract AF 33(600)-41827)
(Rept.-61SD45; AD-600639) OTS: $3.00

This paper discusses various low-density effects on convective heat transfer, and presents useful design information on the individual effects. These low-density effects include the merged viscous layer, slip, viscous interaction, transverse curvature, entropy gradient, nonequilibrium, transition, and free molecule effects. Author

N64-34017* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.
HEAT-TRANSFER AND PRESSURE MEASUREMENTS ON A PRELIMINARY PROJECT FIRE MODEL AT MACH 3.51
Robert L. Stallings, Jr. and Kenneth V. Haggard Washington, NASA, Nov. 1964 23 p refs
(NASA-TN-D-2000) OTS: $0.75

Heat-transfer and pressure measurements have been obtained on a preliminary Project Fire model through an angle-of-attack range from 0° to ±10° at a Reynolds number of 3.6 × 10^6 and a Mach number of 3.51. Heat-transfer measurements were also obtained at a Reynolds number of 2.1 × 10^6. Both heat-transfer and pressure measurements were obtained at the higher Reynolds number with probe-type protuberances simulating external antennas installed on the basic model. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-32813 George Washington U., Washington, D.C. Human Resources Research Office
AN ANNOTATED BIBLIOGRAPHY ON PROFICIENCY MEASUREMENT FOR TRAINING QUALITY CONTROL Research Memorandum
Robert G. Smith, Jr. Jun. 1964 29 p
(Contract DA-44-188-ARO-2)
(AD-448362)

This annotated bibliography on quality control in training includes references from a variety of sources, listed alphabetically by author within the following categories: general, test manuals, test methods, quality-control systems, and test development and description. M.P.G.

N64-32947* Massachusetts Inst. of Tech., Cambridge
MENTALISM IN LINGUISTICS
Jerrold J. Katz Repr. from Language, v. 40, no. 2, Apr.–Jun. 1964 p 124–137 refs
(Grants NsG-496; NSF G-16526; NIH-MH-04737-03; Contracts DA-36-039-AMC-03200(E); AF 19(628)-2487)

The three fundamental questions with which a synchronic description of a particular language deals are these: (1) What is known by a speaker fluent in a natural language? (2) How is such linguistic knowledge put into operation to achieve communication? and (3) How do speakers come to acquire this ability? The difference between taxonomic and mentalistic concepts of linguistics lies in how the theories built on these concepts answer the above questions. Because taxonomic linguistics concern themselves only with facts relevant to structure, whereas mentalistic linguistics seek a full answer to all three questions, the taxonomic concepts are rejected by the mentalist. A.W.

N64-33010 Joint Publications Research Service, Washington, D.C.
INFORMATION THEORY AND PERCEPTION
12 Oct. 1964 76 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 4, Jul.–Aug. 1964 p 3–38, 83–93, 99–114
(JPRS-26839; TT-64-51096) OTS: $3.00

CONTENTS:

1. ON THE PROBLEM OF THE STUDY OF TECHNICAL THINKING T. V. Kudryavtsev and I. S. Yakimanskaya p 1–22 refs

2. AN EXPERIMENT IN APPLYING INFORMATION THEORY TO ANALYSIS OF THE PROCESS OF MAN'S SOLUTION OF THINKING PROBLEMS O. K. Tikhomirov, Ya. Ya. Belik, E. D. Poznyanskaya, and N. Kh. Turchenkova p 23–43 refs

3. CERTAIN FEATURES IN PERCEPTION OF INFORMATION FROM INDICATORS WITH FIGURE AND POINTER SYSTEMS OF READING A. A. Krylov p 44–53 refs

4. ON THE PROBLEM OF THE PROBABILISTIC ANALYSIS OF ELECTROENCEPHALOGRAMS Ye. Ya. Voytinskiy and V. A. Pryanishinikov p 54–61 refs

5. THE RECEPTION AND SUBSEQUENT TRANSMISSION OF A SPEECH MESSAGE V. D. Tunkel p 62–73 refs

N64-33080* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Hampton, Va.
EXAMINATION OF ONBOARD TRAINING FOR EXTENDED SPACE FLIGHTS
Richard Reid and R. T. Saucer Washington, NASA, Nov. 1964 30 p ref
(NASA-TN-D-2162) OTS: $0.75

A method with small weight and volume requirements for maintaining pilot skills for extended space flights was studied. The method makes use of onboard displays, controls, and attitude fuel without degrading the overall system reliability. The method uses electronically generated disturbance signals that are summed with manual control inputs to the attitude stabilization system. The disturbance signals create

perturbations on the spacecraft. The pilot then obtains real training by controlling the attitude of the spacecraft in the presence of the perturbations. Since the disturbance-signal generation requires insignificant weight and volume, the system was evaluated for attitude-fuel requirements in terms of training time available. Author

N64-33159* Naval School of Aviation Medicine, Pensacola, Fla.
THE ELEVATOR ILLUSION: APPARENT MOTION OF A VISUAL TARGET DURING VERTICAL ACCELERATION
Jorma I. Niven, Thomas C. D. Whiteside, (RAF) and Ashton Graybiel 18 Oct. 1963 18 p refs Joint Report with NASA
(NASA Order R-93)
(NASA-CR-59180) OTS: $1.00 fs; $0.50 mf

Two normal and two labyrinthine defective subjects were exposed to vertical accelerations of either less than 1 g or more than 1 g on descent or ascent, respectively, in an elevator, while viewing a real target, a visual afterimage, or a combination of both. Normal subjects tended to perceive an apparent downward movement of the real target when $g < 1$ and an upward shift when $g > 1$; for a visual afterimage, the relationships were reversed. The labyrinthine defectives did not perceive apparent movement of the real target at anytime and were uncertain with respect to the afterimage. Involuntary upward eye movements in response to a change from 1 g to zero g were subsequently demonstrated in normals, but no such movement could be shown in a labyrinthine defective subjects. Author

N64-33208* American Inst. for Research, Pittsburgh, Pa.
HUMAN FACTORS INFORMATION REQUIREMENTS FOR SPACE SYSTEM DEVELOPMENT Quarterly Status Report, 1 Apr.–30 Jun. 1964
[1964] 9 p
(Contract NASr-194)
(NASA-CR-59050) OTS: $1.00 fs; $0.50 mf

Comments from interviews with life scientists, human-factors engineers, and other system-development personnel were organized into 74 individual requirements for improved human-factors information to support the development of space systems. These were evaluated in terms of the development decisions supported and of the relationship of each requirement to other requirements. The 74 requirements are grouped and listed. R.L.K.

N64-33341* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDIES OF MANUAL CONTROL SYSTEMS Progress Report No. 3, 19 Oct. 1963–18 Apr. 1964
15 Sep. 1964 33 p refs
(Contracts NASw-668; AF 33(657)-10124)
(NASA-CR-59258) OTS: $2.00 fs; $0.50 mf

A sampled-data model for the human controller in time-invariant control systems is proposed. The model is based on the Young eye movement and the Lemay–Westcott hand-tracking models. It has a pursuit channel that provides memory for making smooth almost continuous movements, a saccadic channel for making sudden step movements, and a force programer for driving the muscle–hand system. The variable parameters of the model are identified, and the model is extended to systems having time-varying controlled element dynamics in which the human controller adjusts his characteristics to compensate for the variations in these dynamics. Experimental data show that for sudden changes in dynamics the human controller's adaptive process is composed of four phases: (1) detection of a change, (2) stabilization, (3) reduction of accumulated errors, and (4) optimization of dynamics. Author

N64-33352 Ohio State U. Research Foundation, Columbus
VISUAL RECOVERY FROM BRIEF EXPOSURES TO VERY HIGH LUMINANCE LEVELS
Glenn A. Fry and Norma D. Miller Brooks AFB, Tex., School of Aerospace Med. Aug. 1964 30 p refs
(Contract AF 33(657)-9229)
(SAM-TDR-64-36; AD-449479)

The design and calibration of the apparatus for delivering brief, high-intensity flashes from a xenon-filled flash tube are described. A maximum field luminance of 4.4×10^5L was provided by the flash tube seen by maxwellian view. A rotating mirror was synchronized with the flash-tube discharge to produce exposure durations from 42μsec. to 1.4 msec. Field sizes can be varied from a point source to 10°. An adapting field optical system allows the subject to be preadapted to various luminance levels before the flash is received. The criterion measure for recovery times following the flash was the correct identification of Sloan–Snellen test letters. Five different letter sizes were provided subtending visual angles from 41.9 to 10.2 minutes of arc. Some data are reported for five exposure durations of the flash and for five field sizes for the 20.3 minutes of arc test letter at a luminance of 0.0666 ml. Author

N64-33366 California U., Santa Barbara
ADAPTATION OF MAN TO COLD ENVIRONMENTS Annual Progress Report, Sep. 1963–Sep. 1964
Steven M. Horvath [1964] 5 p
(Contract DA-49-193-MD-2202)
(AD-444482)

The objectives and methods of the following experiments are discussed; (1) reactions of young male subjects to an ambient environment of 6° to 8° C; (2) determination of the influence of workloads of varying intensity on the ability of subjects to maintain thermal balance in a cold environment; (3) effects of long-term, 12-hour work or lying exposures at 6° to 8° C; (4) study of surfers and nonsurfers in an investigation of local acclimatization development; (5) adaptation of swimmers to cold; (6) control experiments on long-term (8-hr) work with modification of feeding patterns; and (7) use of combinations of atmospheres to obtain concurrent information on thermal balances and on the psychological alterations. P.V.E.

N64-33410* National Aeronautics and Space Administration, Washington, D.C.
ADAPTABILITY OF HUMANS TO VARIOUS KINDS OF STRESS IN RELATION TO MANNED SPACE FLIGHT [ZUM PROBLEM DER ANPASSUNG DES MENSCHEN AN VERSCHIEDENARTIGE BELASTUNGEN IN HINSICHT AUF DIE BEMANNTE RAUMFAHRT]
K. E. Klein, H. Bruner, D. Jovey, and H. M. Wegmann Nov. 1964 20 p refs Transl. into ENGLISH of a paper presented at the Ann. Conv. of the Wiss. Ges. für Luft- und Raumfahrt, Munich, 8–12 Oct. 1963
(NASA-TT-F-9158) OTS: $1.00 fs; $0.50 mf

Recent findings in the adaptation of man and animals to typical stress conditions encountered in space flight (altitude, heat, cold, physical exertion, acceleration, radiation) are briefly surveyed, with emphasis on research on humans at high altitudes. Differentiation is made between specific responses to a particular stimulus and the more general nonspecific responses

elicited uniformly by several kinds of stimuli. Current knowledge on "cross adaptation" and its product, cross resistance, is summarized in tables. The comparative merits of prolonged conditioning to stress versus intermittent exposure are evaluated. Author

N64-33459 Ohio State U. Research Foundation, Columbus
VISUAL RECOVERY FROM BRIEF EXPOSURES TO VERY HIGH LUMINANCE LEVELS, PART I Final Report
Norma D. Miller Brooks AFB, Tex., School of Aerospace Med. May 1964 78 p refs
(Contract AF 33(657)-9229)
(TDR-2; AD-450072)

Maximum flash field luminances of 5.4×10^5L were produced by a xenon-filled discharge tube seen by maxwellian view. The field diameters were varied from 10° to 20 min of arc, and the flash exposures were varied from 0.04 msec to 1.4 msec. The maximum flash energy was 0.042 cal/cm^2 at the retina, neglecting losses in the ocular media. During most of the experimental work, the maximum flash energy was reduced to 0.012 cal/cm^2 at the retina by the use of an infrared blocking filter. The flash luminances were varied over a 30 to 1 range. The criterion measure for recovery times following the flashes was the correct identification of Sloan–Snellen test letters viewed as bright letters against a dark background. Author

N64-33485 Joint Publications Research Service, Washington, D.C.
MODELING IN LANGUAGE TEACHING AND PROBLEMS OF PROGRAMMED INSTRUCTION
30 Oct. 1964 13 p refs Transl. into ENGLISH from Vestn. Vysshey Shkoly (USSR), no. 7, 1964 p 31–35, 38–40
(JPRS-27166; TT-64-51422) OTS: $1.00

CONTENTS:
1. MODELING IN THE TEACHING OF FOREIGN LANGUAGES V. F. Nechiporenko p 1–4
2. SOME PROBLEMS OF PROGRAMMED INSTRUCTION IN THE LIGHT OF PSYCHOLOGY B. S. Alyakrinskiy p 5–10 refs

N64-33530 Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Research Labs.
MAN'S VERTICAL ACCELERATION WHILE CROUCHING
Donald D. Mueller Aug. 1964 12 p ref
(AMRL-TDR-64-56; AD-607044) OTS: $0.50

The vertical accelerations involved in crouching and returning to the erect position were computed from the measured forces applied by the subject's feet to a force plate. The subjects were instructed to squat, retrieve an object from the floor, and return to the erect position in a normal manner. The average peak accelerations were found to range from 0.118 to 0.166 g. If an astronaut's acceleration pattern is the same under weightlessness, a restraint system or device capable of holding with a force equal to at least one-third the astronaut's earth weight will be required to prevent his feet from leaving the floor when crouching and to prevent launching himself away from the floor when arising from a crouched position. Author

N64-33536 Boeing Co., Seattle, Wash. Aerospace Div.
IDENTIFICATION OF OBLIQUE FORMS Final Report
C. L. Klingberg, C. L. Elworth, and C. L. Kraft Griffiss AFB, N.Y., RADC, Aug. 1964 139 p refs
(Contract AF 30(602)-2965)
(RADC-TDR-64-144; AD-607357)

Accuracy of form recognition was determined for 45 observers who viewed photographic slide projections of nine military-type targets (three each of ships, airplanes, ground vehicles). The views represented in the imagery included five oblique viewing angles and five orientations (compass directions). They were displayed at three levels each of exposure time, image quality (blur), contrast, and scale ratio. Tests of the statistical significance of the differences in performance as a function of changes in oblique angle of view, orientation of target (with respect to compass direction), image quality, luminance contrast, and exposure time revealed that each main effect was significant ($p < 0.05$) for at least eight of the nine target-class–scale-ratio combinations. One interaction, obliquity x orientation, was significant ($p < 0.01$) for all nine combinations. Only 10 of the remaining 81 interactions were significant. Author

N64-33669 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
WORKING DAY OF A SPACE PIONEER. YA. G. GAGARIN RE-ENTERS SPACE TRAINING
V. Belikov 31 Mar. 1964 7 p Transl. into ENGLISH from Izvestiya (USSR), 9 Aug. 1963 p 4
(FTD-TT-64-149/1+4)

This is a description of a working day of the Russian astronaut Gagarin upon his reentry into space training. Several parachute jumps from a practice tower and one parachute jump from a plane are described. G.G.

N64-33689 California U., Los Angeles Biotechnology Lab.
UPPER EXTREMITY PROSTHETICS RESEARCH. HUMAN TRACKING SENSORY MOTOR CONTROL
John Lyman 15 Jun. 1964 30 p
(Contracts N-123(60530)-32857A; VA-V1005p-9779; Grant VRA-RD-1201M-64)
(Rept.-64-30; AD-605240)

This program report contains brief resumes on the following: "Upper Extremity Prosthetics Research"—needs analysis for development of externally powered protheses design specifications, analysis of existing externally powered prostheses, and development of advanced design specifications; "Research on Sensory-Motor Control"; and "Research on the Performance of the Human Operators of Tracking Systems"—performance evaluation of variables of the optical system on the NOTS tracking simulator. G.G.

N64-33960 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 119: PSYCHOLOGICAL RESEARCH ON THE USE OF VERBAL RESPONSE TO REPLACE MOTOR RESPONSE IN PERFORMING OPERATIONS WITH SIGNAL APPARATUS
30 Oct. 1964 7 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 9, Sep. 1964 p 820–821
(JPRS-27172; TT-64-51428) OTS: $1.00

The adoption of different modes of number naming as verbal responses to replace motor responses in the efficient performance of human operations is discussed and studied. Two modes of stimuli-response interactions were studied by signal lights arranged horizontally on a special panel. The choice reaction times to verbal responses and to electronic light responses were recorded. It was found that the operational performance was at its highest with the use of verbal

responses at low frequency of the signals. Upon significant signal-frequency increase and a complex mode of number naming in the verbal response, the rate of gain of information began to decline. G.G.

N64-33690 California Coll. of Medicine, Los Angeles
STUDIES IN NIGHT VISION Third Interim Technical Report, 25 Mar.–25 Jun. 1964
Barbara B. Brown et al [1964] 72 p refs
(Contract DA-44-009-AMC-367(T))
(AD-447092)

The approaches employed in drug development programs, along with time and cost estimates, are discussed. Some specific synthetic chemical approaches are suggested. The survey of literature continued. The present portion of the survey covers the psychologic and physical aspects of perception that are important considerations for establishing tests for perceptual ability by which either drug evaluations or personnel selections can be made. In the experimental work an objective technique has been developed by which ability for visual recall can be quantified. This technique may permit selection of individuals with rapid and accurate recall ability. Additional data suggest that the same test may identify individuals with high visual ability in a red light environment. Author

N64-33761 Joint Publications Research Service, Washington, D.C.
INFORMATION FOR SPORTSMEN ON SENSE ORGANS
A. A. Berzin 3 Nov. 1964 54 p Transl. into ENGLISH of the book "Sportsmenam ob Organakh Chuvstv" Moscow, Izd. "Fizkul'tura i Sport", 1964 p 1–70
(JPRS-27192; TT-64-51447) OTS: $3.00

Examples are given to illustrate the nature of the sensations that arise in the course of performing physical exercises, i.e., in perceiving the movements of one's own body. In addition, the various sense organs or analyzers are briefly described. The musculomotor analyzers; the tactile, temperature, and pain analyzers; the organic analyzers; the vestibular analyzer; the auditory analyzer; and the visual analyzer are considered. It is concluded that the movements of a body cannot be perceived solely by means of one analyzer; however, at some phase of a movement, a specific analyzer (usually the musculomotor) emerges as the leading one. P.V.E.

N64-33855 Joint Publications Research Service, Washington, D.C.
TRAINING OF SCIENTISTS IN THE SOVIET UNION
N. Ye. Lyagushev et al 28 Oct. 1964 30 p Transl. into ENGLISH from Vestn. Vysshey Shkoly (USSR), no. 6, 1964 p 24–28, 39–40, 57–66
(JPRS-27116; TT-64-51372) OTS: $2.00

Three papers that concern training of scientists in the Soviet Union are presented: (1) "The Front of the Struggle for Technical Progress Is Widening"—a discussion of education in Soviet universities; (2) "An Important Day"—an outline of a student's day at the Institute of Radio Electronics and Mining Electromechanics; and (3) "What Should the Mathematics Course Be Like in a Higher Educational Institution?"—the development of a mathematical curriculum for higher educational institutes. P.V.E.

N64-33907 Ohio State U., Columbus Lab. of Aviation Psychology
AN APPLICATION OF BAYES THEOREM AS A HYPOTHESIS-SELECTION AID IN A COMPLEX INFORMATION-PROCESSING SYSTEM Technical Documentary Report, 15 Mar. 1963–31 Jan. 1964
Jack F. Southard, David A. Schum, and George E. Briggs Wright-Patterson AFB, Ohio, AMRL, Aug. 1964 68 p refs
(Contract AF 33(657)-10763)
(AMRL-TDR-64-51; AD-607256)

The first of a series of experiments investigating the value of automated hypothesis-evaluation aids in multiman–machine systems devoted to assessing or diagnosing threat is described. In the experiment, an eight-man team evaluated threats posed by a hypothetical aggressor. The team made these evaluations on the basis of intelligence information gathered during simulated reconnaissance overflights of aggressor's territory. IBM 1401 and 7090 computer facilities generated the highly complex, real-time stimulus environment (data base), which is described in detail. The primary output of the threat-evaluation team was the commanding officer's posterior probabilities estimates as to aggressor's most likely hostile strategies. During half of the experimental trials, the commander had access to computer produced posterior probabilities based upon a modification of the Bayes Theorem. The major experimental issue was whether or not these would aid the commander in his hypothesis evaluation. Also investigated was the effect of data-processing load upon system operation. Author

N64-33960 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 119: PSYCHOLOGICAL RESEARCH ON THE USE OF VERBAL RESPONSE TO REPLACE MOTOR RESPONSE IN PERFORMING OPERATIONS WITH SIGNAL APPARATUS
30 Oct. 1964 7 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 9, Sep. 1964 p 820–821
(JPRS-27172; TT-64-51428) OTS: $1.00

The adoption of different modes of number naming as verbal responses to replace motor responses in the efficient performance of human operations is discussed and studied. Two modes of stimuli-response interactions were studied by signal lights arranged horizontally on a special panel. The choice reaction times to verbal responses and to electronic light responses were recorded. It was found that the operational performance was at its highest with the use of verbal responses at low frequency of the signals. Upon significant signal-frequency increase and a complex mode of number naming in the verbal response, the rate of gain of information began to decline. G.G.

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-32742 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)
A RAPID DISCRIMINATOR [UN DISCRIMINATORE RAPIDO]
C. Dardini and G. Mazza 24 Jul. 1964 11 p ref In ITALIAN *Its* Nota Interna No. 252
(LNF-64/37)

The characteristics of a rapid discriminator used in conjunction with a photomultiplier are given. Trans. by P.F.E.

N64-32775* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

INSTRUMENTATION FOR MEASUREMENT AND CONTROL

John C. Sanders, Clarence C. Get Warshawsky, and Kirby W. Hiller *In its* Conf. on New Technol. 1964 p 119–143 (See N64-32767 24-01) GPO: $1.00

After drawing an analogy between the functions of measurement and control systems and human functions, the principal elements in the control loop are considered—sensors, the information-processing chain, actuators, and final elements. Sensors discussed include spacecraft devices, such as magnetometers, charged-particle detectors, and infrared radiometers, as well as ground-based devices, such as force, torque, temperature and pressure sensors, and various types of flowmeters. The incorporation of these devices into a complete system is discussed. The control of an artificial heart device in heart pump research is cited as an example of the application of aerospace technology to other fields. M.P.G.

N64-32794 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.

PROTOTYPE MONITOR FOR AIRBORNE IODINE AND FISSION PRODUCTS

Joseph W. Adams Jul. 1964 10 p refs
(Contract AT(07-2)-1)
(DP-908) OTS: $0.50

The design is presented of a new system for monitoring gases from the dissolution of irradiated uranium in radiochemical separations processes. The system includes filter paper and activated charcoal to trap particulate activity and iodine vapor; as activity builds up, it is detected by a concentrically mounted GM tube. Early operating experience is discussed. Author

N64-32803 Federal Aviation Agency, Washington, D.C. Systems Research and Development Service

PRESSURE MEASUREMENT FOR PRESSURE ALTIMETRY

William M. Russell Aug. 1964 36 p refs
(RD-64-119)

The report recommends equipment and maintenance standards for use in pressure altimetry. It covers both measuring pressure for calibrating altimeters and measuring pressure to determine altimeter setting. Specifications for advanced automatic equipment are included. Implementation of the recommended standards should reduce calibration errors to acceptable limits. Author

N64-32834* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE DIGITAL TAPE RECORDER ANALYZER

Joseph A. Sciulli Washington, NASA, Oct. 1964 27 p
(NASA-TN-D-1863) OTS: $0.75

The test instrument described was designed for the purpose of performing error analyses on spaceborne digital tape recorders. In addition to its two basic functions of detecting errors in a clock track recorded on tape and performing a parity check, under various test conditions, the analyzer's design flexibility will enable simple modification of future models for increased capability. This report describes the theory of operation of the present model and provides operating instructions, together with complete drawings and component listings. Author

N64-32857* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ULTRAVIOLET PHOTOGRAPHY AND SPECTROSCOPY USING A SPECTRALLY SELECTIVE IMAGE CONVERTER

Lawrence Dunkelman and John Hennes Sep. 1964 20 p refs Presented at the ICO Conf. on Photographic and Spectroscopic Optics, Tokyo and Kyoto, Japan, 1–8 Sep. 1964 Submitted for Publication
(NASA-TM-X-55072; X-613-64-272) OTS: $1.00 fs; $0.50 mf

Visual measurements with a Cs-Te image converter, having a sapphire faceplate and a green phosphor, were made with the following results: (1) Cathode quantum efficiency at 2537 Å is 0.016. (2) Minimal detectable converted 2537 Å irradiance is 4×10^{-5} ergs $cm^{-2} sec^{-1}$. (3) Tube background is undetectable. Mercury spectra obtained with this tube demonstrate the expected high rejection of visible light. Tables are included that list the brightnesses of several extended ultraviolet and visible sources of interest in the space sciences. The luminance of visible sources; the radiance of ultraviolet sources; and the relative brightness, on a photon basis, of spectrally converted ultraviolet sources along with visible sources are tabulated. Author

N64-32890* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

DEVELOPMENT OF VIBROCARDIOGRAPHIC INSTRUMENTATION Final Technical Report

30 Jun. 1964 31 p
(Contract NASw-923)
(NASA-CR-59058; SID-64-1221) OTS: $2.00 fs; $0.50 mf

A program for the development and qualitative analysis of a myocardiographic sensor as a means of evaluating vibrocardiographic data is discussed. The report describes the design, fabrication, and surgical implantation of these myocardiographic strain gage sensors. Postimplant recordings, including left ventricular pressure and electrocardiogram, were taken over a 30-day period. Although the sensor responds to activity of the myocardium over the small area under the sensor, the data obtained indicate that more generalized ventricular activity also can be assessed, especially that related to ventricular volume. Author

N64-32918 Joint Publications Research Service, Washington, D.C.

RIOMETER FOR TWO FREQUENCIES, FOR THE MEASUREMENT OF IONOSPHERIC ABSORPTION

Ch. L. Khodzha-Akhmedov *In its* Izv. VUZov; Radio Eng., No. 3, 1964 21 Oct. 1964 p 186–191 refs (See N64-32901 24-08) OTS: $6.00

Measurement is made simultaneously at two frequencies of ionospheric absorption by the cosmic-noise method. Only one device is used—a self-balancing system. Measuring at two or more frequencies permits the determination of the frequency dependence of the attenuation of the signal, the heights of the absorption regions, and the contributions of individual layers of the ionosphere to the total absorption. A complete description of the riometer is given. A.W.

N64-32927 Harry Diamond Labs., Washington, D.C.

DYNAMIC ANALYSIS OF A PROPOSED WAVE ENERGY TIMER

David S. Bettwy 5 Mar. 1964 17 p
(HDL-TR-1196; AD-447298)

The timer is intended to provide a continuous output shaft motion, as opposed to the incremental motion of other mechanical timers, and to have complete assurance of self-starting without the deterioration of frequency stability usually related to self-starting mechanical timers. The analysis presented is based on a simplified timer system, since the primary objective was to determine if the system could maintain a relatively constant rate of rotation over a usable range of driving torque. Differential equations of motion were derived, and an analog computer was used to solve these equations for several different parameters. The results of the study indicate that the wave energy timer described has a potential use as a mechanical timing device for ordnance applications. Author

N64-32937 General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation
REACTOR INSTRUMENTATION AND CONTROL Progress Report No. 84, Jul. 1–Aug. 31, 1964
30 Sep. 1964 23 p refs
(Contract AT(40-1)-2847)
(GEMP-84) OTS: $2.00

Progress is discussed under two headings: (1) Capacitance Temperature Sensor—testing of a two-element, beryllia–molybdenum probe at temperatures up to 1900° C, and development of an integrated 1650° C probe and readout system, including the use of a single-crystal alumina sensing element; and (2) Development of Nuclear Sensors—fabrication of components for a 60-cps regulating-rod control system, testing on shutdown unit and servodrive amplifier, testing of a new high-temperature compensated chamber at 500° C, and investigation of anodized coatings and magnetic fields to retard low-energy secondary electrons (in order to improve charged fragment neutron detector performance). P.V.E.

N64-32938 Sperry Phoenix Co., Ariz.
ANALYSIS AND EXPERIMENTAL EVALUATION OF AN ELECTROMAGNETIC, NEAR-FIELD POSITION SENSOR
Sep. 1964 49 p refs
(LJ-1262-0210A)

This report presents the results of a preliminary evaluation of an electromagnetic position-sensing device, which has a potential application to the probe-boom steering problem associated with the aerospace plane hypersonic refueling concept. The sensor operates on principles related to the phase properties of the near field generated by magnetic dipoles. All of the relations associated with transmitter and receiver motions are derived in the paper. An experimental model of a sensor was built, and its performance is compared to the theoretical predictions. D.E.W.

N64-32950* Texas U., Austin Defense Research Lab.
A QUARTERLY REPORT OF PROGRESS UNDER U.S. COAST AND GEODETIC SURVEY Quarterly Status Report, 1 May–31 Jul. 1964
C. M. Mc Kinney and D. W. Evertson 7 Oct. 1964 15 p
(Contract CGS-1198)
(QSR-3)

Work has continued on the design and construction of two types of seismometers. The construction of a solion vertical seismometer and a reduced-size solion horizontal seismometer is complete. Shake table experiments have been performed on these instruments. Both instruments were used for evaluation tests. The vertical seismometer performed very well, but the horizontal unit had spurious noise. Reproductions of records made during the tests are included. Author

N64-33002 Suffield Experimental Station, Ralston, Alberta (Canada)
STUDIES ON SHOCK WAVE PRESSURE-TIME GAUGES III: THE SPONTANEOUS CHARGE RELEASE EFFECT
J. C. Muirhead and W. J. Fenrick 6 Feb. 1964 17 p refs
(Suffield-TN-137)

This note describes further studies on spontaneous charge release and absorption in piezoelectric ceramics. Charges that are developed by stressing ceramics (or are impressed on the ceramic from a power source) tend to change the polarities of individual crystals within the ceramics, which thereby "store" charges. Application of pressure pulses assists in returning these modified crystals to their normal state. This in turn releases the stored electrical charges, which show up on pressure–time records as spontaneous charge release or absorption. Author

N64-33021 Owens-Illinois Technical Center, Toledo, Ohio
RESEARCH IN HIGH-TEMPERATURE X-RAY DIFFRACTION TECHNOLOGY
S. M. Lang and E. W. Franklin Wright-Patterson AFB, Ohio, ARL, May 1964 79 p refs
(Contract AF 33(616)-7470)
(ARL-64-82; AD-603584)

The crystallometry of zirconium dioxide, ZrO_2, has been surveyed in the range from room temperature to 1750° C in normal air atmosphere at ambient pressure. Topics studied in some detail have been the hysteresis of the monoclinic–tetragonal zirconia transformation, the axial thermal expansion of tetragonal zirconia to 1750° C, the determination of axial expansion data for platinum and beryllium oxide for use as sample temperature indicators, and new mathematical solutions of the classical d-value equations for lattice constants calculations. Significant physical properties and constants can be measured for ZrO_2 if the oxygen stoichiometry is established and maintained at an (unknown) equilibrium, or pseudo-equilibrium, value. Author

N64-33042* Pittsburgh U., Pa. Graduate School of Public Health
AUTOMATIC MICROSCOPE. DIGITAL SCANNER AND COMPUTER PROGRAMMING FOR BIOMEDICAL RESEARCH Third Quarterly Progress Report, 1 Jan.–31 Mar. 1964
17 Aug. 1964 6 p
(Contract NASr-169; NSF GP-2310)
(NASA-CR-58872) OTS: $1.00 fs; $0.50 mf

This report pertains to the development of an apparatus to transmit information from an automatic microscope to the computer. Preliminary specifications for an automatic microscope and a scanner device to convert the light image of the mitotic cell into a digital form have been investigated. Requirements for maintenance equipment and supplies have been established. G.G.

N64-33096* Chicago U., Ill. Satellite and Mesometeorology Research Project
THE SCANNING PRINTER AND ITS APPLICATION TO DETAILED ANALYSIS OF SATELLITE RADIATION DATA
Tetsuya Fujita Jul. 1964 32 p refs
(Grants NsG-333; CWB-WBG-6; NSF G-18984)
(NASA-CR-58975; SMRP-34) OTS: $2.00 fs; $0.50 mf

In order to improve the time-consuming analyses of TIROS radiation data for use in mesometeorological studies, a scanning printer was designed and constructed. The printer output is a coded printout on a translucent sheet, which can be

reproduced by a dry diazo process for further analysis of radiation patterns. Because the data are printed out on parallel straight lines that correspond to the curved scan lines on the earth, the patterns contoured directly on the printout sheet are distorted. Nevertheless, the unsmoothed patterns thus obtained give much higher resolution than that expected from FMRT listings or grid print maps currently available to researchers. This improved printout capability, together with the superimposed grid lines of longitudes, latitudes, solar zenith angles, solar backscattering angles, satellite zenith angles, etc., now makes it possible to interpret TIROS radiation data in relation to mesoscale disturbances. Author

N64-33166* Geophysics Corp. of America, Bedford, Mass.
A SOLAR ASPECT SENSOR FOR SOUNDING ROCKETS
P. J. Mc Kinnon and L. G. Smith Jul. 1964 35 p Presented at the IEEE Region 3 Ann. Meeting and Tech. Conf., Clearwater, Fla., May 1964
(Contract NASw-820)
(NASA-CR-58844; GCA-TR-64-12-N) OTS: $2.00 fs; $0.50 mf

This paper contains a detailed description of a solar aspect sensor, the operation of which is dependent on a silicon solar energy convertor. Special attention is given to the reasons that led to the choice of a photovoltaic device for the application and to the analysis of the geometry by which the aspect concept is realized. Some comparisons with the earlier version of the solar aspect sensor are made to indicate the improvements. The instrument measures the angle between the spin axis of the rocket and the sun–rocket line for angles between 20° and 160° with an accuracy of ±1° Author

N64-33184* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A SYSTEM FOR MEASURING THERMAL EXPANSION OF METALLIC AND NON-METALLIC MATERIALS AT CRYOGENIC TEMPERATURES
W. N. Clotfelter and L. A. Soileau 17 Jul. 1964 15 p
(NASA-TM-X-53090) OTS: $1.00 fs; $0.50 mf

An apparatus consisting of a quartz dilatometer, the associated cryostat, and necessary instrumentation was designed. Movements of the dilatometer are measured with a commercial interferometer. The same cryostat and vacuum system are used to determine the expansion characteristics of metallic and nonmetallic materials. Only the specimen holders and respective auxiliary fixtures are changed for the various types and sizes of specimens. Because of slow operation with the optics, the optical system was replaced with an electronic measuring system that is based on differential transformers. D.E.W.

N64-33223* Pennsylvania State U., University Park Ionospheric Research Lab.
A PROBE ASSEMBLY FOR THE DIRECT MEASUREMENT OF IONOSPHERIC PARAMETERS Scientific Report No. 223(E)
L. C. Hale 20 Oct. 1964 33 p refs
(Grant NsG-134-61)
(NASA-CR-59136) OTS: $2.00 fs; $0.50 mf

A direct probe for measurement of ionospheric parameters—positive ion density, composition, and temperature, electron temperature, and vehicle potential—is described in detail. The design has been implemented by the construction of a rugged, reliable, lightweight electronics assembly with simple automatic range switching of the electrometer sensitivity to both positive and negative current ranges, circuitry for extracting the time derivative of the probe current waveform, in-flight calibration of system sensitivity, and automatic switching from an ion mode to an electron mode of operation. Author

N64-33250 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INTENSITY MEASUREMENT IN NEAR FIELDS AND REVERBERANT SPACES
P. W. Smith, Jr., T. J. Schultz, and C. I. Malme 24 Jul. 1964 115 p refs
(Contract Nonr-3468(00))
(BBN-1135; AD-603713)

The usefulness of direct measurements of vector intensity for the calibration of acoustic transducers has been studied by laboratory experiments in anechoic and reverberant chambers and by analysis. Determination of total power output is feasible by intensity measurements in the near field and in reverberant spaces, situations where pressure measurements would be inadequate without elaborate calculation. However, the directional distribution of intensity differs from the desired far-field, free-space directivity both near a source and far from a source but in a reverberant space. Analysis shows no theoretical way to correct for these differences. In some limited circumstances, even though intensity measurements do not yield the exact directivity pattern, the differences may be acceptable. Author

N64-33275 Sperry Gyroscope Co., Great Neck, N.Y.
ELECTROMAGNETIC ANGULAR ROTATION SENSING Final Report
W. Macek, R. Salamon, D. Davis, and E. Cheatham Wright-Patterson AFB, Ohio, AF Avionics Lab., Aug. 1964 111 p refs
(Contract AF 33(657)-11433)
(AB-1272-0011; AL-TDR-64-210; AD-605818)

Studies have been conducted on adapting the traveling-wave ring laser for rotation sensing. The three wavelengths of the He-Ne gas system (0.6328μ, 1.1523μ, 3.39μ) have been employed in external cavities with perimeters of 8, 4, and 1 m. The latter two were free to rotate; the 8-m ring was designed to be tilted only, so as to vary the detected component of the earth's rotation. Various optical combiners were evaluated to minimize coupling between the oppositely directed waves while maximizing S/N ratios and permitting the sense of rotation to be determined without recourse to biasing. Coupling effects due to dust particles and mirror surface imperfections were also considered in relation to their effects on mode locking. A region of nonlinear oscillation just prior to frequency pulling and locking, at low rotation rates, has been clearly established and related to the mode coupling problem. Author

N64-33292* Michigan U., Ann Arbor
[CONTINUED RESEARCH, RELEVANT TO METEOROLOGICAL SATELLITES IN ADVANCED MEASURING TECHNIQUES OF HIGH ALTITUDE] Fifth Quarterly Status Report, 1 Feb.–30 Apr. 1964
Fred L. Bartman and L. M. Jones 30 Jul. 1964 6 p ref *Its* Rept.-05863-5-P
(Contract NASr-54(03))
(NASA-CR-59250) $1.00 fs; $0.50 mf

The hemispherical cavity source has been used to calibrate visible channels of TIROS and Nimbus 5-channel radiometers and to calibrate the Perkin–Elmer SG-4 spectrophotometer in the 0.4μ to 1.0μ range. The thermal channels of Nimbus MRIR radiometers were also recalibrated after the aircraft flight tests. Design and construction of equipment for the next balloon flight, analytical study of atmospheric radiation processes, study of the transmission of starlight through the atmosphere to determine the shape and spectral intensities of the star image incident on the star-tracker photosurface, and the development of an infrared interferometer for spacecraft are discussed. E.C.

N64-33294 Fairchild Camera and Instrument Corp., Syosset, N.Y. Space and Defense Systems
IMAGE INTERPRETATION CELL Final Report
V. Abraham, A. Dobbs, and J. K. Libby Griffiss AFB, N.Y., RADC, Aug. 1964 150 p
(Contract AF 30(602)-2882)
(SME-AA-101; RADC-TDR-64-102; AD-606895)

The purpose of the Image Interpretation Cell is to generate forward echelon accurate intelligence data in the form of flash and immediate photo-interpretation reports. Each cell accepts all the incoming material that meets the requisites of the overall Limited War Intelligence Reduction Complex (LWIRC) and, from this material, can provide reports within the specified time periods; that is, one hour for flash reports, and six hours for immediate reports. The IIC performs three basic functions for each mission: (1) preparation, retrieval, and sequencing of data prior to analysis of the multisensor reconnaissance inputs; (2) detection, recognition, and interpretation of requested and bonus targets; and (3) conversion and reduction of raw intelligence data to usable or specified report form. Author

N64-33348 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
AN ELECTRICAL CONDUCTIVITY-VELOCITY INSTRUMENT USING STEADY APPLIED MAGNETIC FIELD
A. E. Fuhs, R. Betchov, O. L. Gibb, and J. R. Abshear 21 Aug. 1964 28 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-158; TDR-269(4280-50)-3; AD-449824)

A flight instrument using a permanent primary magnetic field has been developed. The flight instrument can measure plasma flows with σU equal to 10^4 (mho/m)(m/sec). In order to reduce the data it is necessary to determine the no-flow reference level, $eE(\theta,\phi)$, which requires knowledge of the vehicle's motion. The instrument could be adapted for use with plasma flows, such as MHD generators. Since the transducer has fixed orientation relative to external magnetic fields the sensitivity could be increased so that σU equal to 10^3, and possibly 10^2(mho/m)(m/sec), could be measured. Author

N64-33376* Consolidated Controls Corp., Bethel, Conn.
PRESSURE MEASURING SYSTEMS FOR CLOSED CYCLE LIQUID METAL FACILITIES Second Quarterly Report, 1 Jun.–31 Aug. 1964
Richard E. Engdahl, ed. 28 Sep. 1964 69 p refs
(Contract NAS3-4170)
(NASA-CR-54193, CCC-443) OTS: $3.00 fs; $0.75 mf

Continuing development of a series of pressure transducers for liquid metal systems is described. Problems encountered in fabricating the pressure capsule are outlined along with the anticipated solutions. The experimental program for completing the evaluation of the thermionic and variable impedance detector systems is described. Some details of the test facility are discussed. These include the liquid potassium test capsules and the method of measuring diaphragm deflection. Author

N64-33414 Argonne National Lab., Ill. Reactor Physics Div.
AN INTRODUCTION TO MULTICHANNEL ANALYZERS
George S. Stanford Apr. 1964 23 p refs
(Contract W-31-109-ENG-38)
(ANL-6881) OTS: $0.50

A survey of the state-of-the-art of multichannel pulse analysis is presented, intended chiefly for the reader with little prior knowledge of the field. There is no attempt to treat any topic in depth. The general principles of analysis of pulse height and time of flight are outlined, with consideration given both to single-parameter and to multiparameter instruments. Memory systems, analog-to-digital conversion, and readout devices are discussed. Some of the features and limitations of modern analyzers are noted, and typical performance specifications are given. Author

N64-33473 Atomic Energy of Canada Ltd., Chalk River, Ontario
A HIGH RANGE GAMMA RAY SURVEY METER
A. R. Jones and B. Banville Jul. 1964 13 p ref
(AECL-2042)

A gamma survey meter to measure exposure rates in the range 2 to 500 r/hr is described. It comprises a regulated high-voltage supply, a miniature halogen counter tube, and a meter for measuring the current flowing in the counter tube. It includes a probe, at the end of which the counter tube is mounted, and this can be extended from two to five feet. Measurements of factors affecting accuracy are presented and discussed. The calibrating procedure is described. Author

N64-33492 Weizmann Inst. of Science, Rehovoth (Israel)
WEAK FERROMAGNETIC GAUSSMETER
S. Shtrikman and D. Treves 20 Aug. 1964 8 p refs
(Contract AF 61(052)-654)
(TN-9; AD-605722)

A torque magnetometer G.E.-type gaussmeter using weak ferromagnetic rotors is described. This instrument gives a reading essentially linear with fields up to 10^5 gauss. The actual torques are higher than those obtained with paramagnetic or diamagnetic rotors, even at 10^5 gauss. An experimental instrument was built and found to yield a linear reading up to the highest field available, i.e., 25 kgauss. Author

N64-33502 AirTechnology Corp., Cambridge, Mass.
NON-CHOPPING RIOMETER WITH CW AND PULSE INTERFERENCE—REJECTION CIRCUITRY, VOLUME I AND II Final Report 191-2
J. Maxwell Aug. 1964 99 p
(Contract AF 33(657)-12075; ARPA Order-159)
(AD-446633)

An engineering prototype of a nonchopping riometer was designed, constructed, and tested to have an extended capability for operation in the presence of interference. The performance of the riometer in a low-noise environment fully matched the expected performance, and even exceeded it in respect to the system sensitivity and stability. In the extremely-high-noise environment of the field tests, the interference-rejection circuitry functioned well but still displayed its limitations. Broadband interference, from local sources of pulsed interference such as auto and truck ignitions, is not removed by the frequency-diversity circuitry. If the interference as a whole tends to fill the two-dimensional frequency–time domain, then the windows through which the cosmic noise may be visible tend to shrink toward an ultimate opacity. D.E.W.

N64-33528 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A DEVICE TO DETERMINE THE TEMPERATURE OF PLASMA
G. A. Boberskiy 29 Sep. 1964 5 p Transl. into ENGLISH from Russian patent No. 148551 (Appl. No. 733451/26-10, Jun. 7, 1961)
(FTD-TT-64-604/1+2; AD-607183)

A pulsed incandescent lamp whose brightness temperature can reach 15 000° K is used to provide a continuous spectrum background against which the individual spectral lines originating in the plasma or flame are measured. The invented device

consists of an incandescent lamp, a pulsed lamp, photo shutters, lenses, a monochromator, photodetectors, and a double beam oscillograph. D.E.W.

N64-33560* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ULTRAVIOLET SPECTROPHOTOMETER FOR SATELLITE ASTRONOMY
Kenneth Hallam and John Mangus Jul. 1964 14 p refs Presented at the ICO Conf. on Phot. and Spectroscopic Optics, Tokyo, 1–8 Sep. 1964
(NASA-TM-X-55079; X-610-64-188) OTS: $1.00 fs; $0.50 mf

The entrance slit of the spectrophotometer defines the field at the primary focus of a 6-inch Gregorian reflecting telescope. The secondary serves as the collimator for a rotating 1200 lines/mm plane reflection grating. Diffracted light from the grating is collected by an off-axis paraboloid and focused through the exit slit to the photomultiplier. The signal from the photomultiplier is pulse counted and fed into the magnetic tape storage of the spacecraft. The instrument utilizes the spin of the gyroscopically stabilized satellite to sweep the 1° × 0.4° field over the celestial sphere. Slow precession of the spin axis allows eventual coverage of the whole sky. Author

N64-33612* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INSTRUMENT FOR DETERMINING SQUARENESS OR PERPENDICULARITY
Edwin White *In its* Precision Tooling Tech. Oct. 1964 p 9–11 (See N64-33608 24-17) GPO: $0.25

The Indicator Differential (IN-DIF) Measuring Device reduces the number of personnel and time required to determine the squareness or perpendicularity of machined parts. The instrument was machined with two sets of three positioning pads lapped at right angles to each other. The upright gage member has 19 holes, 3/8 inch in diameter on 1/2 inch centers, for insertion of the indicator differential gages. The IN-DIF eliminates all vertical movement and can be set in 1/2-in. vertical increments, up to 10 inches. Slight angles can be determined because the difference in the readings of the two indicators, considering their spacing, is the sine of the angle. P.V.E.

N64-33613* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TOOL FOR MEASURING DEVIATION FROM PARALLEL
William J. Abernathy *In its* Precision Tooling Tech. Oct. 1964 p 13–14 (See N64-33608 24-17) GPO: $0.25

Measurements of parallelism can be made to within 10 microinches at any time during the manufacture of precision parts by the use of a simple device incorporating an air gage. The instrument consists of an air bearing, a 10000-to-1 air gage, and a precision-lapped air-bearing cylinder. The top surface of the cylinder is serrated to serve as a table for the part to be measured. The part to be measured is secured to the table by a special screw and washer and is rotated slowly under the air gage pickup. The motion of the gage indicator gives a direct reading on the location and amount of deviation from parallel in the part. P.V.E.

N64-33668 Litton Systems, Inc., St. Paul, Minn. Applied Science Div.
AN AIRCRAFT IMPACTOR FOR DETERMINING THE SIZE DISTRIBUTIONS OF TROPOSPHERIC AEROSOLS
W. L. Torgeson and S. C. Stern 8 Apr. 1964 26 p refs
(J-1038; AD-447855)

The design and development of an aircraftborne isokinetic sampling device for collecting and fractionating tropospheric aerosol particles is described. The device incorporates a two-stage impactor and a backup filter for collection and fractionation of atmospheric particles. Author

N64-33678* Arizona U., Tucson Lunar and Planetary Lab.
CONSTRUCTION OF A 60-INCH LUNAR AND PLANETARY TELESCOPE
Gerard P. Kuiper 1 Oct. 1964 3 p ref
(Contract NASr-82)
(NASA-CR-59164) OTS: $1.00 fs; $0.50 mf

The development of the F/4 61-inch full-aperture paraboloid is in the final phase. The Foucault knife-edge test at the center of the curvature revealed an estimated accuracy of $\lambda/4$ of the full parabolic correction. A null lens has been designed and fabricated. Two hyperbolic convex secondary mirrors giving focal ratios of F/45 and F/13.5 were completed. G.G.

N64-33753 Naval Ordnance Test Station, China Lake, Calif. Research Dept.
ABNORMAL CHARACTERISTICS OF INTERFERENCE FILTERS
Allen L. Olsen and Karen E. Plain Jun. 1964 11 p refs
(NAVWEPS-8550; NOTS-TP-3575; AD-603632)

Three narrow bandpass multilayer dielectric "spike" filters have been investigated as secondary standards in wavelength calibration of spectrophotometers. In the process of calibrating the spike filters in the 2μ range with a Cary 14 spectrophotometer, it was found that the wavelengths of the peaks were sensitive to specimen rotation in the energy beam, and that, in several instances, interference patterns were produced throughout the trace. It was also observed that the peak wavelengths were sensitive to the location of the specimen within the sample compartment. In all three filters, specimen rotation produced the greatest shift in wavelength at the focal plane and the least shift at the monochromator end of the cell holder. Even in the latter case, the spread of values greatly exceeded the ± deviations of the wavelength reproducibility of the instrument and the accuracy of the wavelength standard. Author

N64-33775* Ohio State U. Research Foundation, Columbus Antenna Lab.
RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVE LENGTHS Annual Summary Report, 1 Sep. 1963–31 Aug. 1964
1 Sep. 1964 15 p refs *Its* Rept.-1093-22
(Grant NsG-74-60)
(NASA-CR-59335) OTS: $1.00 fs; $0.50 mf

The submillimeter radiometer was improved by the addition of an analog-to-digital tape system to guide the aperiodic mode data directly into the computer; a new germanium bolometer also improved the signal-to-noise ratio. The resistivity of the carbon bolometer material was determined as a function of temperature, and the static responses were calculated from heat equations. Measurements of the solid spectroscopy at submillimeter laser length on the exchange-coupled levels of concentrated ruby at liquid helium temperatures were obtained. G.G.

N64-33800 Chalmers U. of Tech., Goteborg (Sweden)
OPTIMIZED PERFORMANCE OF THE VIDICON
Ove Strindehag Scand. U. Books, 1963 62 p refs *Its* Trans. No. 265 Available from Scand. U. Books: 15 SK

The performance of the vidicon under various conditions is studied in order to estimate the usefulness of this camera

tube in scientific applications. Investigations are carried out on the ability of the vidicon to work in different illumination and contrast regions and to reproduce objects in motion. Special attention is devoted to the properties of the vidicon at very low target illumination and to the possibility of transmitting pictures with an extremely high number of picture elements. Author

N64-33894 Watervliet Arsenal, N.Y. Benet R & E Labs
AN EVALUATION OF COLOR RADIOGRAPHY FOR INDUSTRIAL USE: THE RE-EXPOSURE METHOD
Carl Blackman May 1964 30 p refs
(WVT-II-6410; AD-603633)

Although no color film is specifically manufactured for radiographic purposes, attempts have been made to produce color radiographs by modifying the producer's suggested film-development procedure. Step wedges of aluminum, steel, zirconium, and uranium were radiographed, and the film-developing process was modified. The results, using a positive- and a negative-type film, and a detailed record of the procedures are presented. The results indicate that color radiographs are difficult to produce, and the process is time consuming and expensive. Author

N64-33933 Rensselaer Polytechnic Inst., Troy, N.Y.
AUTOMATIC POLARIZATION APPARATUS Scientific Report No. 3
B. E. Wilde and N. D. Greene 15 Jun. 1964 12 p refs
(Contract AF 19(604)-8377)
(AFCRL-64-518; AD-606678)

An apparatus that automatically measures and records anodic and cathodic polarization curves on semilogarithmic coordinate paper is described. Conventional and potentiostatic measurements can be performed at potential sweep rates between 2×10^{-2} and 9×10^{2} V/hr reproducible within $\pm 1\%$. Author

N64-33947 Illinois U., Urbana
ACOUSTIC PRESSURE TRANSDUCER
R. C. Dimick and G. J. Trezek Aug. 1964 15 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(ILL-16-P; AD-445933)

A low-cost pressure transducer is described that is based on the change in impedance of a permanent magnet loudspeaker as the air density surrounding it changes. This device is useful for pressure measurements in the range from 0.2 to 15 psi. Author

N64-33956 Michigan U., Ann Arbor Infrared Lab.
GEOMETRIC DISTORTIONS IN FIELD OF VIEW OF ROTATING-OBLIQUE MIRROR SCANNING SYSTEM
William L. Brown and Frank D. Farley Aug. 1964 22 p
(Contract DA-28-043-AMC-00013(E), Proj. Michigan)
(Rept.-6400-10-T; AD-446627)

The geometric distortions in the field-of-view of rotating-oblique-mirror scanners are analyzed; particular attention is given to single-element systems, multielement linear-array systems, and circular element systems. The exact analysis is followed by useful approximations of sufficient accuracy for computational purposes. General conclusions are reached that may be used as a guide for assessing and correcting for the distortions in the displayed imagery. Author

N64-34016* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
PRELIMINARY EXPERIMENTAL INVESTIGATION OF A DOUBLE CAPACITOR COINCIDENCE DISCHARGE-TYPE MICROMETEOROID PENETRATION SENSOR
Frank G. Pollack, Paul C. Winslow, Jr., and Elmer H. Davison Washington, NASA, Nov. 1964 40 p refs
(NASA-TM-X-1037)

A reusable capacitor-type micrometeoroid-penetration sensor for detecting penetrations of a structural metal specimen was investigated. Metallic-coated dielectric films were bonded to each side of structural metal specimens, thus forming two parallel plate capacitors with the structural metal forming the common plate. A counting circuit requiring coincidence discharge of both capacitors served to eliminate false counts. Self-healing permitted the capacitors to recharge thereby regaining the usefulness of the sensor. Test sensors employing a variety of thicknesses of structural metal, dielectric films, and vapor-deposited metallic films were evaluated. Structural metal thicknesses from 1 to 10 mils, dielectric film thicknesses from 0.15 to 1.0 mil, and vapor-deposited aluminum film thicknesses from 500 to 10 000 Å were investigated. The test sensors were impacted in ambient air and in vacuum to 10^{-5} torr by small, hypervelocity particles with velocities from 7000 to 45 000 feet per second to simulate micrometeoroids. The particles included both metallic and nonmetallic materials and ranged in diameter from 1μ to 350μ. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-32741* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography, 23 Aug.–8 Sep. 1964
Oct. 1964 154 p refs
(NASA-SP-7011(03)) OTS: $1.00

The subjects covered are the biological, physiological, pyschological, and environmental effects to which man is subjected during and following simulated or actual flight in the atmosphere or in space. Also included are effects on biological organisms of lower order, and such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life-support systems, exobiology, and personnel factors. Three organizations contribute to the publication—NASA, the American Institute of Aeronautics and Astronautics, and the Library of Congress. R.L.K.

N64-32747 Joint Publications Research Service, Washington, D.C.
PROTEINS OF THE NERVOUS SYSTEM
A. V. Palladin 12 Oct. 1964 17 p Transl. into ENGLISH from Priroda (Moscow), no. 7, 1964 p 24–31
(JPRS-26846; TT-64-51103) OTS: $1.00

The greatest activity of protein exchange takes place in the areas that are rich in nerve cells with the most intensive exchange characteristic for the proteins of the microsomes

and ribosomes of the subcellular structures of the brain tissue. More water-soluble proteins are contained in the gray matter of the brain than in the white matter, and the soluble brain proteins were studied by electrophoresis on agar-agar. It was found that the brain proteins are divided into 16 groups. G.G.

N64-32748 Joint Publications Research Service, Washington, D.C.

THE MECHANISM OF THE CHANGE IN THE FUNCTIONS OF THE THYROID GLAND DURING STRESS

Yu. B. Skebel'skaya 15 Oct. 1964 21 p refs Transl. into ENGLISH from Probl. Endokrinol. i Gormonoterap. (Moscow), v. 7, 1962 p 111–118

(JPRS-26911; TT-64-51168) OTS: $1.00

The reaction of the organism to stress involves not only the ACTH of the anterior lobe of the hypophysis and the corticosteroid hormones of the adrenal cortex, but also the thyroid gland and the posterior lobe of the hypophysis. The importance of the hypothalmic area and the higher department of the central nervous system in regulation of rapid excretion of ACTH and ADH in response to injuries is stressed. G.G.

N64-32750 Joint Publications Research Service, Washington, D.C.

RESEARCH IN RADIOBIOLOGY

19 Oct. 1964 124 p refs Transl. into ENGLISH of 14 articles from Vopr. Radiobiol., Sb. Trudov (Yerevan), v. 3–4, 1963 p 53–57, 59–69, 71–109, 197–215, 275–281, 283–287 (JPRS-26956; TT-64-51212) OTS: $4.00

CONTENTS:

1. THE EFFECTIVENESS OF SPECIFIC GAMMA-GLOBULIN'S PROPHYLACTIC ACTION FOR VACCINE-INDUCED KERATITIS IN IRRADIATED AND NON-IRRADIATED RABBITS L. A. Kamalyan and Zh. Ts. Vartevanyan p 1–7 refs

2. A STUDY OF THE PROPERTIES OF VACCINE VIRUS IN X-IRRADIATED AND NON-IRRADIATED TISSUE CULTURE L. A. Kamalyan, Zh. Ts. Vartevanyan, and E. L. Shakhnazaryan p 8–14 refs

3. STUDY OF X-IRRADIATED AND VACCINE-VIRUS INOCULATED TISSUE CULTURE BY THE LUMINESCENT MICROSCOPY METHOD L. A. Kamalyan and R. A. Ter-Pogosyan p 15–21 refs

4. STUDY OF T_1 PHAGE REPRODUCTION IN X-IRRADIATED E. COLI B CELLS R. A. Ter-Pogosyan and A. T. Ter-Avetisyan p 22–29 refs

5. A COMPARATIVE STUDY OF VACCINE VIRUS REPRODUCTION IN X-IRRADIATED AND NON-IRRADIATED TISSUE CULTURE L. A. Kamalyan, R. A. Ter-Pogosyan and Zh. Ts. Vartevanyan p 30–36

6. EFFECT OF IONIZING RADIATION ON THE IMMUNOLOGICAL REACTIVITY OF THE RETICULO-ENDOTHELIAL SYSTEM (RES) E. D. Stepanyan p 37–53 refs

7. EFFECT OF RADIATION DOSE RATE ON THE PHAGOCYTIC AND ANTIBODY-FORMING FUNCTIONS OF THE RETICULO-ENDOTHELIAL SYSTEM (RES) D. Stepanyan p 54–60 refs

8. THE SIGNIFICANCE OF THE IRRADIATION SITE FOR THE EFFECT OF IONIZING RADIATION ON THE PHAGOCYTIC AND ANTIBODY-FORMING FUNCTIONS OF THE RETICULO-ENDOTHELIAL SYSTEM (RES) E. D. Stepanyan p 61–71 refs

9. BETA-RADIOACTIVITY OF CERTAIN SAMPLES OF ANIMAL BONES, GRASS AND SOIL V. O. Ovanesyan, M. L. Arutyunyan, A. A. Mirzoyan, and Ts. A. Mirzadyan p 72–77 refs

10. SKELETAL RADIOACTIVITY OF NEWBORN CHILDREN M. L. Arutyunyan, V. A. Akopova, and V. O. Ovanesyan p 78–83 refs

11. IMMUNOBIOLOGICAL CHANGES IN IRRADIATED GUINEA PIGS WITH TULAREMIA S. A. Papoyan, V. N. Zil'fyan, and K. M. Dekhtsunyan p 84–98 refs

12. A STUDY OF THE INITIAL PHASE OF THE INTERACTION BETWEEN VACCINIA VIRUS AND IRRADIATED TISSUE CULTURE CELLS S. A. Papoyan, R. A. Ter-Pogosyan, L. A. Kamalyan, Zh. Ts. Vartevanyan, A. G. Ter-Avetisyan et al p 99–108 refs

13. SOME DATA ON THE EFFECT OF COLAMINE ON THE DEVELOPMENT OF VACCINIA VIRUS AND THE FORMATION OF SMALLPOX IMMUNITY G. V. Kamalyan, L. A. Kamalyan, R. A. Ter-Pogosyan, Zh. Ts. Vartevanyan, and A. T. Ter-Avetisyan p 109–115 refs

N64-32776 Joint Publications Research Service, Washington, D.C.

RECENT WORKS ON "SKIN VISION," THE CENTRAL NERVOUS SYSTEM, AND RADIATION SICKNESS

6 Oct. 1964 40 p refs Transl. into ENGLISH from Byull. Eksptl. Biol. i Med. (Moscow), v. 29, no. 8, 1964

(JPRS-26725; TT-64-41982) OTS: $2.00

CONTENTS:

1. THE MECHANISM OF OSMORECEPTOR STIMULATION L. K. Velikanova and Ya. D. Finkinshteyn p 1–5 refs (See N64-32777 24-16)

2. "SKIN VISION" S. N. Dobronravov and Ya. R. Fishelev p 6–10 refs (See N64-32778 24-16)

3. THE PROBLEM OF THE DEVELOPMENT OF THE RELATIONSHIP BETWEEN OPTIC AND SKIN PERCEPTION OF LIGHT IN MAN P. G. Snyakin p 11–17 refs (See N64-32779 24-16)

4. CLINICO-HEMATOLOGICAL, BIOCHEMICAL, AND MORPHOLOGICAL CHANGES IN THE RESTORATIVE PERIOD DURING THE THERAPY OF RADIATION SICKNESS Ye. A. Abaturova, N. K. Sviridov, G. N. Yelpat'yevskaya, and Ye. A. Zuykova p 18–24 refs (See N64-32780 24-16)

5. PROPHYLACTIC ACTION OF AEROIONIZATION IN ACUTE RADIATION SICKNESS L. V. Serova and M. I. Fedotova p 25–30 refs (See N64-32781 24-16)

6. SENSITIVITY OF THE RABBIT CENTRAL NERVOUS SYSTEM TO A CONTINUOUS ULTRA-HIGH FREQUENCY ELECTROMAGNETIC FIELD Z. M. Gvozdikova, V. M. Anan'yev, I. N. Zenina, and V. I. Zak p 31–37 refs (See N64-32782 24-16)

N64-32777 Joint Publications Research Service, Washington, D.C.

THE MECHANISM OF OSMORECEPTOR STIMULATION

L. K. Velikanova and Ya. D. Finkinshteyn *In its* Recent Works on "Skin Vision," the Central Nervous System, and Radiation Sickness 6 Oct. 1964 p 1–5 refs (See N64-32776 24-16)

OTS: $2.00

The regulation of osmomolar concentrations of an organism's internal media is realized by neurohumoral systems that are an aggregate of osmoregulatory reflexes. It is established that osmotic shift is evoked easily by introduction of small quantities of 3% to 5% hypertonic solution of sodium chloride, glucose, NaCl iso-osmotic with respect to this solution, and several other substances into the organ's arterial system. Studies in the movement of sodium and water in the blood—interstitial liquid system at a hypertonic shift—are discussed. It was found that the osmomolar concentration of venous blood during injection of a physiological solution does not change

when injection of a hypertonic solution evokes a decrease of osmotic pressure. As a result of hyperosmosis in the capillaries, diffusion of sodium appears in the interstitial area with the simultaneous movement of water in the reverse direction. E.C.

N64-32778 Joint Publications Research Service, Washington, D.C.

"SKIN VISION"

S. N. Dobronravov and Ya. R. Fishelev *In its* Recent Works on "Skin Vision," the Central Nervous System, and Radiation Sickness 6 Oct. 1964 p 6–10 refs (See N64-32776 24-16) OTS: $2.00

Thresholds of tactile, vibrational, thermal, and color sensitivity of the skin on the fingers of the patient were determined. Studies were made to determine the influence of light, temperature of the surrounding environment, and damage of blood circulation in the fingers on the capability to determine the color and composition of drawings,. Experiments to disprove the "tactile" and "thermal" hypotheses are presented. Observations of the phenomenon of "skin vision" are noted. In "skin vision" perception, the field of vision appears to be very small. E.C.

N64-32779 Joint Publications Research Service, Washington, D.C.

THE PROBLEM OF THE DEVELOPMENT OF THE RELATIONSHIP BETWEEN OPTIC AND SKIN PERCEPTION OF LIGHT IN MAN

P. G. Snyakin *In its* Recent Works on "Skin Vision," the Central Nervous System, and Radiation Sickness 6 Oct. 1964 p 11–17 refs (See N64-32776 24-16) OTS: $2.00

Physiological research was conducted on the perception organs, particularly the sensory devices of the skin and eyes and their relationship to each other. Under conditions of total exclusion of visual perception, the patient had exceedingly high and fine sensitivity of the finger epidermis in differentiating light and color, and in reading and distinguishing drawings with the third and fourth fingers of the right hand. These fingers also have high sensitivity to tactile, pain, and thermal receptors. Relationship of skin photosensitivity with the ability of neural termini of the skin to perceive chemical reactions occurring under the influence of light is discussed. E.C.

N64-32780 Joint Publications Research Service, Washington, D.C.

CLINICO-HEMATOLOGICAL, BIOCHEMICAL, AND MORPHOLOGICAL CHANGES IN THE RESTORATIVE PERIOD DURING THE THERAPY OF RADIATION SICKNESS

Ye. A. Abaturova, N. K. Sviridov, G. N. Yelpat'yevskaya, and Ye. A. Zuykova *In its* Recent Works on "Skin Vision," the Central Nervous System, and Radiation Sickness 6 Oct. 1964 p 18–24 refs (See N64-32776 24-16) OTS: $2.00

Experiments on dogs exposed to general Roentgen radiation in a dosage of 600 R are discussed. This dosage corresponds to LD 80/30 and evokes an acute form of radiation sickness with hematologic manifestations. Immediately after radiation, all animals were given batyl alcohol (batylol) and leucogen tablets of 0.02 g each. After 6 to 7 days, one tablet of kafiride was given to each animal; they also received Biomycin and Levomycetin. The complex of chemical preparations increased the possibility of survival of irradiated animals and passage of radiation sickness. Any measure of successful therapeutic action of preparations used in the treatment of radiation sickness should be considered from their influence on the organism as a whole, and not as individual processes occurring in it that are disrupted by ionizing radiation. E.C.

N64-32781 Joint Publications Research Service, Washington, D.C.

PROPHYLACTIC ACTION OF AEROIONIZATION IN ACUTE RADIATION SICKNESS

L. V. Serova and M. I. Fedotova *In its* Recent Works on "Skin Vision," the Central Nervous System, and Radiation Sickness 6 Oct. 1964 p 25–30 refs (See N64-32776 24-16) OTS: $2.00

Ionization of rats by electroeffluviant aeroionizer, using the Ravich system, was conducted prior to irradiation to ascertain the effect of positive or negative aeroionization on radiational diseases. Animals irradiated with 700 R were observed for 30 days. The dynamics of death, weight, temperature of the body, indicators of gas exchange, and the condition of peripheral blood were studied. The difference in action of positive and negative aeroions under experimental conditions was found to be only quantitative, and hinges upon the fact that for attainment of a positive effect, a very short course of positive aeroionization is needed as compared with that of a course of negative aeroionization. E.C.

N64-32782 Joint Publications Research Service, Washington, D.C.

SENSITIVITY OF THE RABBIT CENTRAL NERVOUS SYSTEM TO A CONTINUOUS ULTRA-HIGH FREQUENCY ELECTROMAGNETIC FIELD

Z. M. Gvozdikova, V. M. Anan'yev, I. N. Zenina, and V. I. Zak *In its* Recent Works on "Skin Vision," the Central Nervous System, and Radiation Sickness 6 Oct. 1964 p 31–37 refs (See N64-32776 24-16) OTS: $2.00

The purpose of this study is to evaluate the sensitivity of the rabbit's central nervous system to continuous uhf electromagnetic fields of different, chiefly nonthermal intensities with long waves of 12.5 and 52 cm, and of 1 meter. Analysis of the distribution curve of latent periods on a temporal scale leads to the conclusion of a higher sensitivity of the central nervous system to electromagnetic fields of the metric range. A field with a wavelength of 52 cm has a lower biological effectiveness, and an even lower sensitivity to an electromagnetic field with a wavelength of 12.5 cm was exhibited. E.C.

N64-32796 Joint Publications Research Service, Washington, D.C.

PHYSIOLOGICAL REACTIONS OF ANIMALS DURING FLIGHTS ON THE THIRD, FOURTH, AND FIFTH SPACESHIP-SATELLITES

O. G. Gazenko, I. I. Kas'yan, A. R. Kotovskaya, Ye. M. Yuganov, and V. I. Yazdovskiy 20 Oct. 1964 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSSR, Ser. Biol. (Moscow), No. 4, Jul./Aug. 1964 p 497–510
(JPRS-26994; TT-64-51250) OTS: $1.00

Flights of experimental animals into the near space on cosmic spaceship–satellites showed an absence of pathological changes in the circulatory and respiratory systems during and after flight. Functional changes in basic physiological functions of the animals were the most pronounced during the orbital insertion of the ship and its return to earth. During the period of weightlessness indices of the cardiovascular system in the majority of the dogs returned to initial values by the second to third orbit. During the condition of weightlessness, both an increase and a decrease in respirations was noted. Author

N64-32833* General Technical Services, Inc., Cleveland, Ohio

STUDY OF THE GENERAL DYNAMICS OF THE PHYSICAL-CHEMICAL SYSTEMS IN MAMMALS

A. S. Iberall Washington, NASA, Oct. 1964 119 p refs (Contract NASw-1066) (NASA-CR-129) OTS: $2.75

Development of ideas of how the biological systems are coordinated for regulation and control purposes is discussed. The discussion is divided into the following areas: (1) temperature regulating system; (2) cardiovascular system—geometry-topology of the arterial system, and regulation and control in the cardiovascular system; (3) reprise on the cardiovascular and thermoregulating systems; (4) the nature of living systems; (5) hormonal dynamics—the water oscillator, 2-minute heat-production cycle, 7-minute blood-flow cycle, 30-minute metabolic-product-release cycle, and 3-day water-balance cycle; and (6) behavioral systems—Freud Libido theory of psychosexual development, M. Klein's theoretic views, and H. S. Sullivan's views. Transmission–attenuation characteristics of the arterial system are discussed in an appendix. P.V.E.

N64-32865 Adaptronics, Inc., Alexandria, Va.
A COMPILATION OF BIOLOGICAL LAWS, EFFECTS, AND PHENOMENA, WITH ASSOCIATED PHYSICAL ANALOGS
Final Report
L. O. Gilstrap, Jr., J. S. Mc Neil, L. P. Greenberg, and R. B. Spodak Wright-Patterson AFB, Ohio, AF Avionics Lab., Jun. 1964 613 p refs
(Contract AF 33(657)-7099)
(AD-604369)

A compilation of biological laws, effects, and phenomena and their associated physical analogs is presented. Information on each law, effect, or phenomenon is contained in separate entries that are grouped roughly into sections by similarity of content. Entries are cross referenced by animals and plants mentioned in each entry, by sample physical devices, systems, effects or phenomena analogous to the described biological law, effect or phenomenon in each entry, and by physical class (i.e., by the branch of physical science most relevant to the biological description), and by physical operator (i.e., by the categories of sensor, transformer, or actuator, whichever is more nearly descriptive of the entry). Author

N64-32954 Joint Publications Research Service, Washington, D.C.
EFFECTS OF SOUND AND NUCLEIC ELEMENTS ON CELLS
5 Oct. 1964 17 p refs Transl. into ENGLISH of 3 articles from Izv. Sibirsk. Otd. Akad. Nauk SSSR, Ser. Biol.-Med. Nauk, Novosibirsk), no. 4, Sept. 1, 1964
(JPRS-26712; TT-64-41969) OTS: $1.00

CONTENTS:

1. THE STIMULATING EFFECT OF HIGH-FREQUENCY ULTRASOUND ON THE REPRODUCTION OF YEAST CELLS G. S. Komolova and N. P. Gracheva p 1–5 refs (See N64-32955 24-16)
2. ON THE RELATIONSHIP BETWEEN THE ELEMENTS OF A NUCLEUS AND THE CYTOPLASM D. F. Petrov p 6–10 refs (See N64-32956 24-16)
3. THE ACTION OF ULTRASOUND IN YEAST RIBONUCLEIC ACID SOLUTIONS IRRADIATED WITH AND WITHOUT CAVITATION IN THE MEDIUM M. S. Levinson and V. P. Nefedov p 11–14 refs (See N64-32957 24-16)

N64-32955 Joint Publications Research Service, Washington, D.C.
THE STIMULATING EFFECT OF HIGH-FREQUENCY ULTRASOUND ON THE REPRODUCTION OF YEAST CELLS
G. S. Komolova and N. P. Gracheva *In its* Effects of Sound and Nucleic Elements on Cells 5 Oct. 1964 p 1–5 refs (See N64-32954 24-16) OTS: $1.00

The stimulating effect of ultrasound upon the growth of yeast in a synthetic nutritive medium and in a naturally nutritive medium was investigated. High ultrasonic frequencies were used in order to expose the microorganisms to sound with sufficient intensity, without causing cavitation in the medium. It is concluded that with suppression of cavitation in the medium, ultrasonic waves can increase the output of biological mass in yeast production. P.V.E.

N64-32956 Joint Publications Research Service, Washington, D.C.
ON THE RELATIONSHIP BETWEEN THE ELEMENTS OF A NUCLEUS AND THE CYTOPLASM
D. F. Petrov *In its* Effects of Sound and Nucleic Elements on Cells 5 Oct. 1964 p 6–10 refs (See N64-32954 24-16) OTS: $1.00

A hypothesis is outlined that can be used to elaborate the following problems: (1) the change in the phenotypical manifestation of a number of interacting genes in *cis-* and *trans-*position and the "position effect" in connection with the inclusion of informational RNA of such genes in one or various ribosomes; (2) the problem of the stage development and aging as a result of accumulation in the cytoplasm of ribosomes with various forms of long-lived informational nucleic acid; (3) the problem of the possibility of the transmittal of hereditary information of somatic cells with changes in the hereditary structure into the sexual cells, by means of the transmittal via the body fluids, of the nucleic acid and the subsequent inclusion of that nucleic acid in the chromosomes of the sexual cells. P.V.E.

N64-32957 Joint Publications Research Service, Washington, D.C.
THE ACTION OF ULTRASOUND IN YEAST RIBONUCLEIC ACID SOLUTIONS IRRADIATED WITH AND WITHOUT CAVITATION IN THE MEDIUM
M. S. Levinson and V. P. Nefedov *In its* Effects of Sound and Nucleic Elements on Cells 5 Oct. 1964 p 11–14 refs (See N64-32954 24-16) OTS: $1.00

Experiments carried out in order to study the influence of ultrasound upon nucleic acids (particularly ribonucleic acid) are discussed. The results of the experiments established that cavitational frequencies (0.8 Mc/sec) and noncavitational frequencies (2.4 and 4.0 Mc/sec) exert different influences upon the RNA molecule. The effect of elastic oscillations, which occur at noncavitational frequencies, does not cause any changes in the RNA molecules. Measurements were also made of pH in the RNA solutions of various concentrations before and after exposure to ultrasound, and in the distilled water used in the experiments. It was found that changes in pH in the solutions exposed to ultrasound depended upon the RNA concentration. In a 0.2% solution of RNA exposed to ultrasound, there was no drop in the pH. P.V.E.

N64-32981 School of Aerospace Medicine, Brooks AFB, Tex. Dental Sciences Lab.
CORTISONE ORAL GLUCOSE TOLERANCE RESPONSES IN HEALTHY YOUNG ADULT MALES CLASSIFIED AS TO ORAL HEALTH STATUS
Ira L. Shannon and William A. Gibson Sep. 1964 13 p refs (SAM-TDR-64-57; AD-449445)

Cortisone-supplemented oral-glucose tolerance tests were carried out on 156 apparently healthy young adult males. Results were compared with those from 300 other subjects

who underwent conventional oral-glucose tolerance testing. All subjects were classified as to dental caries experience and periodontal index rating. The addition of cortisone to the oral-glucose tolerance-testing procedure increased the means for serum glucose at each sampling interval. In neither the conventional nor the cortisone-supplemented groups was there a significant indication that glucose tolerance responses could be related to either dental caries experience or periodontal index. Author

N64-32986 Western Australia U., Perth
REPORT ON RESEARCH, 1 JULY 1962–31 DECEMBER 1963
[1963] 284 p

This is a research report containing current programs of the departments of physics, chemistry, civil and electrical engineering, and mathematics. G.G.

N64-33019* Mississippi State U., State College
AN EXTRACELLULAR POLYSACCHARIDE PRODUCED BY *PALMELLA MUCOSA* KUTZ
R. G. Tischer and B. G. Moore Repr. from Arch. Mikrobiol. (Berlin), v. 49, 1964, p 158–166 refs
(Grant NsG-80)

This paper pertains to the extracellular polysaccharide produced by the algae *Palmella mucosa* Kütz and its composition; the effects of different carbon and nitrogen sources on its synthesis; the rate of its formation; and its biosynthetic route. G.G.

N64-33041* California U., Los Angeles UCLA Health Sciences Center
NORMAL SLEEP PATTERNS IN THE MACAQUE MONKEY
M. L. Reite, J. M. Rhodes, E. Kavan, and W. R. Adey [1963] 29 p refs
(Grant NsG-505)
(NASA-CR-59001) OTS: $2.00 fs; $0.50 mf

The electrical activity of the cortex and various deep-brain structures of the monkey *Macaca nemestrina* during sleep was observed by bipolar surface and implanted EEG electrodes, and to a sound stimulus the average evoked responses are by eye movements. The sleep phases were found to be cyclic, resembling human sleep, but the longest segment occured in the early part of the night. G.G.

N64-33044* Schwarz Bioresearch, Inc., Orangeburg, N.Y.
SUPERIOR DIET FOR MAN IN SPACE Quarterly Report, Apr.–Jul. 1964
Norman A. Rosenthal Jul. 1964 35 p refs
(Contract NASw-517)
(NASA-CR-59003) OTS: $2.00 fs; $0.50 mf

The means for introducing additional calcium into liquid diets to permit establishment of favorable Ca/P ratios was achieved by solubilizing insoluble Ca_3 (citrate)$_2 \cdot 4H_2O$ in the chelated form, i.e., Ca_3 (citrate)$_2 \cdot 10$ H citrate. Followup studies of the effects of liquid diet concentration and water balance on rat survival reveal that in terms of growth response, diet concentrations of 30% appear to be optimal, regardless of whether or not the animals are allowed free access to a source of water. In a comparison of the relative merits of glucose and the water soluble polymeric form of glucose, i.e., dextran, as dietary sources of energy, a mixture of 80% glucose–20% dextran appeared to be more efficient than the use of glucose alone. Preliminary studies of the comparative effects of increased caloric supplementation of the diet with both glucose and lipids indicate that carbohydrates may be favored over lipids. Comparative studies of the relative merits of L-methionine and L-ethyl cysteinate·HCl reveal that the presence of the latter definitely exerts a growth inhibitory effect. Author

N64-33058 Joint Publications Research Service, Washington, D.C.
BERYLLIUM AND ITS RELATION TO INDUSTRIAL HYGIENE
22 Oct. 1964 81 p refs Transl. into ENGLISH from RUSSIAN periodicals
(JPRS-27031; TT-64-51287)

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N64-33095* Lockheed-California Co., Burbank Physical and Life Sciences Lab.
INVESTIGATION OF THE EFFECTS OF IONIZING RADIATION ON THE CENTRAL NERVOUS SYSTEM IN VIVO AND IN VITRO
Eberhardt K. Sauerland and Robert S. Gordee Jul. 1964 84 p refs
(Contract NASw-787)
(NASA-CR-58974; LR-18025) OTS: $3.00 fs; $0.75 mf

The effects of ionizing radiations on the central nervous system of cats were investigated by using deeply implanted brain electrodes. In cats exposed to 4000- and 2000-r head X-irradiation, a profound effect was seen in the form of a high-voltage slow-wave syndrome. Subcortical areas such as the hippocampus and the amygdaloid nuclei showed spontaneous spiking and at higher doses gradually became isoelectric. A significant lowering of the seizure threshold also appeared, and cortical postirradiation effects seemed to appear later and secondary to subcortical effects. Measurements in the hippocampus showed an immediate drop in impedance magnitude after irradiation, followed by extensive excursions in the magnitude of resistive and reactive components and in their ratio. In exploring the effects of ionizing radiation at the cellular level much effort was devoted to establishing satisfactory experimental approaches. Techniques for the growth of neurons and neuroglial cells in vitro are described. R.L.K.

N64-33099* National Research Corp., Cambridge, Mass. Research Div.
STUDY OF VIABILITY OF MICROORGANISM IN SIMULATED SPACE Final Report, Apr. 21, 1963–May 31, 1964
Gerald J. Silverman, Cecil B. Dunn, Ray Barrett (MIT), Rosario P. Giammanco, and Philip Blum 10 Aug. 1964 22 p
(Contract NASw-773; NRC Proj. 81-1-0102)
(NASA-CR-59092) OTS: $1.00 fs; $0.50 mf

Among spores of four test organisms subjected to uhv and ultraviolet radiation, *A. niger* proved the most resistant; *B. megaterium*, *B. subtilis*, and *B. stearothermophilus* proved about equally less resistant. All four spores were less radio-resistant when uhv-dried than when air-dried. Among spores of four test organisms subjected to uhv and gamma radiation, *B. megaterium* proved the most resistant; *A. niger* proved least resistant; *B. subtilis* and *C. sporogenes* were of intermediate resistivity. All four spores were less radio-resistant when uhv-dried than when wet. Microbial flora of dried desert soil withstood 200° C simultaneously with uhv for five days. Soil isolates showed considerably less resistivity, however, thus confirming that soil serves as a protective agent against thermal destruction. Three vegetative microorganisms subjected simultaneously to elevated temperatures and uhv showed a rapid decrease in survival as temperatures rose above approximately 50° C. Author

N64-33102 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CHANGES IN THE STEREOTYPE OF CONDITIONED RESPIRATORY REFLEXES AND RESPIRATORY RESPONSES TO CO_2 UNDER THE INFLUENCE OF CHLORPROMAZINE
Yu. N. Ivanov and Ye. I. Semeyko 2 Mar. 1964 13 p refs
Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 13, no. 4, 1963 p 680–685
(FTD-TT-64-69/1+2+4; AD-432209)

The effects of chlorpromazine on the respiratory mechanism of dogs were studied by exposure to a mixture of 2.5% to 3% carbon dioxide and air before and after the injection of chlorpromazine at 2 to 3 mg/kg of weight. The animals were prepared by removing of the vision, auditory, and olfactory receptors and by exposing the vagus nerve on the neck. The course of respiratory conditioned and unconditioned responses was observed by the rhythmic stereotype of respiratory conditioned reflexes to four positive and four differential alternating stimuli. It was found that changes of the respiratory responses to carbon dioxide by administration of chlorpromazine are more pronounced in the control animals than in the dogs deprived of the sensory mechanisms and observation during the course of respiratory conditioned and unconditioned responses under the effect of chlorpromazine point to the cerebral cortex of higher animals as being the main site of the closure of conditioned reflex temporary connections. G.G.

N64-33104 Göttingen U. (W. Germany)
QUINOID COMPOUNDS IN PHOTOSYNTHETIC REACTIONS OF ISOLATED CHLOROPLASTS Scientific Report No. 1
A. Trebst 1 May 1964 11 p refs
(Contract AF 61(052)-716)
(AFCRL-64-760; AD-448996)

The quinone-stimulated photo-oxidation of ascorbate in isolated chloroplasts is coupled to ATP formation and is inhibited by DCMU. The stoichiometry of one ATP to one H_2O_2 formed suggests a tight binding of ascorbate photo-oxidation onto the electron transport chain of chloroplasts. The p-phenylendiamines reverse the DCMU inhibition of photosynthetic NADP-reduction. This reaction is not coupled to ATP formation, excluding a photophosphorylation site between the first light reaction of photosynthesis and NADP-reduction. The light inactivation of the Hill reaction with ferricyanide in chloroplasts is prevented by the addition of minute amounts of substituted quinones. Author

N64-33124* Stanford Research Inst., Menlo Park, Calif.
STUDIES ON THE HILL REACTION ACTIVITY OF SOLUBLE CHLOROPLAST EXTRACTS Quarterly Progress Report No. 6, 1 Jun.–31 Aug. 1964
Lloyd K. Moss and Janice E. B. Coomber 8 Oct. 1964 5 p
(Contract NAS4-49(11))
(NASA-CR-59220) OTS: $1.00 fs; $0.50 mf

The mechanisms and essential reactants of that part of the photosynthetic process in which oxygen is produced by photolysis of water are being studied. The manometric polarographic electrode method of measuring Hill reaction activity was begun. Chloroplast fragment preparations were studied for oxygen-evolving activity as a function of the amount of biocatalyst. P.V.E.

N64-33138 Atomic Energy Commission, Washington, D.C. Div. of Biology and Medicine
REPORTS ON ATOMIC RADIATION SUBMITTED TO THE UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION, SUPPLEMENT 2 An Atomic Radiation Bibliography, 15 May 1962–1 Jun. 1964
Alfred W. Klement, Jr., comp. Jun. 1964 23 p
(TID-3909 (Suppl. 2)) OTS: $0.50

N64-33189* Space/Defense Corp., Birmingham, Mich.
[RESPIROMETER AND LIFE SUPPORT SYSTEM FOR A POTATO IN SPACE ENVIRONMENT] Second Quarterly Status Report, 4 May–14 Aug. 1964
Donald L. Foster 31 Aug. 1964 10 p
(Contract NASw-870)
(NASA-CR-58945; TR-64-107) OTS: $1.00 fs; $0.50 mf

Problems encountered in the development and operation of a breadboard respirometer and life-support system to maintain a potato specimen in a simulated space environment for a period of 90 days are discussed. Performance tests of the total system and evaluation of the breadboard instrument are presented in detail; it appears that the instrument is operating satisfactorily. E.C.

N64-33195* Harvard U., Cambridge, Mass.
[EFFECTS OF HIGH ENERGY PROTONS ON BIOLOGIC PROCESSES AND LIVING SYSTEMS] Seimannual Status Report, Jan. 15–Jul. 15, 1964
Raymond N. Kjellberg and William H. Sweet [1964] 17 p refs
(Grant NsG-262-63)
(NASA-CR-5887) OTS: $1.00 fs; $0.50 mf

A neuro-opthalmological test was devised to determine a biological end point for proton-beam tolerance of the II-VI cranial nerves. In another investigation monkeys were spin-irradiated in the lower thoracic region at the mid-dorsal level, using a knifelike proton beam for determination of anatomic change. The technique of making two focal lesions in the two hemispheres of a monkey's brain and comparing their size as a measure of biological effect was extended to measure the effect of dose rate. The effect of low-dosage long-term total-body proton radiation as a defense against bacterial invasion was studied. A technique of measuring the amount of halogen acid produced in the HAP dosimeter by ionizing radiation was developed. Other studies involved intercranial Bragg peak proton

irradiation of humans for various disorders, biologic protection against proton radiation, quantitative histopathology, electrophysiologic changes, behavioral changes, mammalian proliferative tissues and cells, mapping of dose distributions, and quantitative positron scanning. R.L.K.

N64-33211* Martin Co., Baltimore, Md. RIAS Div.
RESEARCH IN PHOTOSYNTHESIS Quarterly Report No. 5, 6 Jun.–6 Sep. 1964
Bessel Kok [1964] 7 p
(Contract NASw-747)
(NASA-CR-59204) OTS: $1.00 fs; $0.50 mf

Efforts to reactivate photosynthesis in dark, cold, aged bean leaves were concentrated on the restoration of Hill activity in inactive chloroplasts by addition of cofactors, compounds with oxidation–reduction capacity, and protein fractions of active chloroplast from bean leaves in an attempt to localize the lesion in photosystem II. Described are the effects of adding several auto-oxidizable compounds to the oxygen exchange rate in the illumination of chloroplasts. To test the interaction between photophosphorylation and photoevolution of oxygen, various compounds were added to phosphorylation uncouplers in an attempt to reverse their inhibition of oxygen evolution. *Chrisomonad Ochromonas danica* and a mutant of *Scenedesmus* were studied as sources of photosynthetic information. Improvement difference spectroscopy has yielded a time resolution that is compatible with that of the cat, which is equivalent to 60μsec per station; the apparatus was able to observe in chloroplasts a very fast decaying photoconversion and possibly a consecutive reaction with a half-time of 100 to 200 μsec. R.L.K.

N64-33261* Rochester U., N.Y.
ILLUMINATION DEPENDENCE OF ENHANCEMENT
T. T. Bannister and M. J. Vrooman Repr. from "Photosynthesis Mech. in Green Plants", Publ. No. 145, Washington, NAS-NRC, 1963 p 391–399 refs
(Grant NsG-(T)-73)

The subject of this paper is the dependence of enhancement in *Chlorella pyrenoidosa* str. 3, on short-wave (482 mμ) and far-red (696 mμ) illuminations. Two enhancement functions were determined, the enhancement (E) and the excess (D): $E = (p_{12}-p_1)/p_2$ and $D = p_{12}-p_1-p_2$. Here p_1, p_2, and p_{12} are the steady-state photosynthesis rates in short-wave, far-red, and the two lights together, respectively. To facilitate reference to illumination curves of photosynthesis, p_1, p_2, p_{12}, and D were expressed as rates relative to the saturated rate in white light. The observed functions $E(I_1, I_2)$ and $D(I_1, I_2)$ were compared with these predicted by the "spill-over" and "separately packaged pigment" models of enchancement. The predicted functions, which are the same for both models, explain many, but not all, characteristics of the observed functions. Author

N64-33264* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
LOCAL, SEGMENTAL AND SUPRASPINAL INTERACTION WITH A DORSOLATERAL SPINAL CUTANEOUS AFFERENT SYSTEM
Arthur Taub Repr. from Exptl. Neurol., v. 10, no. 4, Oct. 1964 p 357–374 refs
(Grants NsG-496; AF-AFOSR-591-64; NIH MH-04737-04; Contracts DA-36-039-AMC-03200(E); AF 33(615)-1747)

The mutability of the receptive field characteristics of single units in the spinocervical tract of the cat through local, segmental, and supraspinal mechanisms is demonstrated in decerebrate and spinal preparations. Locally, a discrete, nonconcentric, easily fatiguable afferent inhibition, produced by light brushing and cold, is described. Segmentally, strong stimulation of the distal extremities is found to inhibit spontaneous or evoked activity in the spinocervical tract in a variety of patterns that are suggested to be related to reflex progression. Electrical stimulation of the mesencephalic tegmentum, cerebellar nuclei, and a central pontobulbar core is shown to produce a 35% constriction of receptive field area and a generalized decrease in receptive field responsiveness, with the preservation of a small, sensitive, "central" region. Author

N64-33277* Chicago U., Ill. Research Inst.
INTEGRATED RESEARCH AND TRAINING PROGRAM IN MOLECULAR BIOLOGY (ULTRASTRUCTURE AND ELECTRON MICROSCOPY) Annual Progress Report, 1963–1964
Humberto Fernandez-Moran [1964] 73 p
(Grants NsG-441-63; AT(11-1)-1344 Res; NIH PHS-MR-943)
(NASA-CR-59151) OTS: $3.00 fs; $0.75 mf

Described and pictured are the laboratories that allow high-resolution electron microscopy independent of ambient conditions on almost a 24-hour basis, operating under "clean room" conditions. The research program includes the following: (1) continuation of correlated electron microscope and biochemical studies of mitochondrial membranes, which have resulted in the detection and isolation of a fundamental unit of energy transduction (electron transfer particle); (2) electron microscopic and biochemical studies of pyruvate dehydrogenase complex of *Escherichia coli*; (3) application of low-temperature methods (cryofixation), using liquid helium II; (4) electron microscope and electron diffraction studies of DNA macromolecules in pollution, using such special techniques as vacuum-tight microchambers, low-intensity microbeam illumination, etc; (5) correlated electron microscope and electron diffraction studies of certain meteorites (Orgueil carbonaceous chondrite); (6) electron microscopy studies of Precambrian organized systems; and (7) development of techniques for electron optical examination of extraterrestrial matter. R.L.K.

N64-33284* Naval School of Aviation Medicine, Pensacola, Fla.
DOSIMETRIC EVALUATION OF DATA ON THE SOLID ANGLE BREAKDOWN OF SHIELD THICKNESS FOR THE APOLLO VEHICLE
Hermann J. Schaefer 19 Aug. 1964 19 p refs Joint report with NASA
(NASA Order R-75)
(NASA-CR-59266) OTS: $1.00 fs; $0.50 mf

Detailed data on the directional shielding characteristics of the Apollo vehicle are evaluated for a typical flare-produced proton spectrum with regard to residual flux and depth distribution of absorbed dose and enders count in a tissue phantom in the command module. By replacing the actual irregular distribution of shield thickness by an equivalent ordered arrangement, the computational analysis is greatly simplified, yet still allows establishing upper and lower limits for the exposure in the actual system. Total dose and enders count in the surface vary between 1.27 and 0.45 rads/hour or 282 and 68 enders/sec $gram_T$, respectively. Minimum depth dose is 0.23 rads/hour or 28 enders/sec $gram_T$. The complex relationships governing the percentage distribution of solid angles of different shield thicknesses to the exposure are investigated. Author

N64-33286* Chicago U., Ill.
ANALYTICAL SYSTEMS FOR BIOLOGICAL STUDY OF MARS. THE ROLE OF ELECTRON MICROSCOPY AND ELECTRON OPTICAL TECHNIQUES IN EXOBIOLOGY
Humberto Fernández-Morán [1964] 10 p refs
(Grant NsG-441)
(NASA-CR-59251) OTS: $1.00 fs; $0.50 mf

The advantages and problems of low-temperature electron microscopy are discussed. With this technique, labile structures can be observed more clearly and thermal vibrations are suppressed. The experimental method is detailed and illustrated by directly examining the phase transitions of ice from cubic to hexagonal form. Preliminary data are presented on the possibility of sectioning unfixed, rapidly frozen, biological tissue. Plans for a cryogenic microscope are presented. This device has the advantages of perfect vacuum, a completely stable set of superconducting lenses, and the absence of thermal vibrations. D.E.W.

N64-33288* Republic Aviation Corp., Farmingdale, N.Y. Space Environment and Life Sciences Lab.
STUDY OF THE NORMAL FECAL BACTERIAL FLORA OF MAN Quarterly Progress Report, 1 Jul.–30 Sep. 1964
Lorraine S. Gall 6 Oct. 1964 8 p
(Contract NASw-738)
(NASA-CR-59257; RAC-931-5) OTS: $1.00 fs; $0.50 mf

The work was primarily concerned with isolation of bacteria from normal healthy males and the study of their carbohydrate metabolism. A rapid morphological-type culture screening was also set up, in addition to the regular-type culture screening. Microscopic examination of fecal dilutions revealed a number of readily distinguishable morphological types of bacteria that recurred frequently. In assessing reproducibility of the techniques used, it was generally found that the morphological types in duplicate dilution tubes were very dissimilar. Fecal anaerobe-type cultures were studied further in an attempt to identify them according to Bergey's manual. In manometric fermentation-balance studies, cultures were tested for their ability to ferment glucose, lactose, maltose, and starch. The FA-4, 5, 6, and 11 had similar fermentation patterns. Starch was utilized at a higher rate than glucose, which is characteristic of *Actinomyces bifidus*. R.L.K.

N64-33331* Naval School of Aviation Medicine, Pensacola, Fla. Bur. of Medicine and Surgery
ORIENTATION OF THE ROTATION-AXIS RELATIVE TO GRAVITY: ITS INFLUENCE ON NYSTAGMUS AND THE SENSATION OF ROTATION Report No. 96
Fred E. Guedry, Jr. 30 Jun. 1964 26 p refs
(NASA Order R-93)
(NASA-CR-59286) OTS: $2.00 fs; $0.50 mf

Subjective phenomena and nystagmus were compared under two conditions of rotation, one in which the axis of rotation was vertical, i.e., aligned with gravity, and one in which the rotation-axis was horizontal. When the axis of rotation was horizontal, normal subjects exhibited nystagmus and sensations of rotation for periods of three minutes (and longer); deceleration produced very brief postrotational reactions. L-D subjects, men presumed to be without vestibular function, did not exhibit nystagmus or report sensations comparable to those of normal subjects for either the vertical or horizontal axis of rotation. Because prolonged nystagmus occurred almost exclusively in normal subjects when the rotation axis was horizontal, it is concluded that vestibular function is a necessary condition for this response and that it may be dependent upon the continuous reorientation of the otolith system relative to gravity. Author

N64-33344 Joint Publications Research Service, Washington, D.C.
SEQUENTIAL PROBLEMS IN SOVIET BIOCHEMISTRY
N. M. Sisakyan 26 Oct. 1964 17 p Transl. into ENGLISH from Usp. Sovrem. Biol. (Moscow), v. 57, no. 3, 1964 p 337–349
(JPRS-27063; TT-64-51319) OTS: $1.00

This article gives an overall view concerning methods of investigations of physiochemical processes in biochemistry and their applications in industry. An analysis of these processes, not only on the molecular level but also on the submolecular level, with the help of quantum chemistry is predicted. The synthesis of pure enzymes by methods of separation of proteins by fractionation, particular zone electrophoresis, chromatography with ion-exchange resins on a cellulose base, and by filtering through gels with molecular sieve properties is pointed out. G.G.

N64-33345 Joint Publications Research Service, Washington, D.C.
THE CHEMICAL BASES OF THE VIRULENCE AND PATHOGENICITY OF MICROORGANISMS
Ye. M. Gubarev 29 Oct. 1964 20 p refs Transl. into ENGLISH from Usp. Sovrem. Biol. (Moscow), v. 58, no. 1 (4), Jul.-Aug. 1964 p 74–85
(JPRS-27146; TT-64-51402) OTS: $1.00

This article covers mainly those enzymes of bacterial cells that contribute to the virulence and pathogenicity of microorganisms. The chemical factors, and especially the bacterial enzymes and their toxins, neurotoxins, lecithinase, and decarboxylase in the pathogenesis of several infections, are discussed. G.G.

N64-33391* National Aeronautics and Space Administration, Washington, D.C.
THE EFFECT OF WATER REMOVAL AND ABSORPTION ON METABOLISM DURING HUNGER [UBER DEN EINFLUSS VON WASSERENTZIEHUNG UND WASSERAUFNAHME AUF DEN STOFFWECHSEL BEIM HUNGERN]
W. Axenoff Sep. 1964 9 p refs Transl into ENGLISH from Z. Biol. (Munich), v. 90, 1930 p 50–56
(NASA-TT-F-9106) OTS: $1.00 fs; $0.50 mf

In order to determine the relationship between water balance and nitrogen metabolism, a research program was designed to observe a long series of fasting days while comparing periods of complete dehydration and of moderately elevated water intake (to 1700 cc). Results showed that water retention and intake affect the nitrogen and uric acid in the urine even when urine volume is unchanged, while sodium chloride, ketonuria, and ammonia secretion are not affected. Body weight shows increases corresponding to water intake and limited by water retention. E.C.

N64-33392* National Aeronautics and Space Administration, Washington, D.C.
COMPARATIVE EFFECT OF DISTILLED WATER, VICHY WATER AND EQUIMOLECULAR SOLUTIONS IN EXPERIMENTAL AQUEOUS PLETHORA [ACTION COMPAREE DE L'EAU DISTILLEE, DE L'EAU DE VICHY ET DES SOLUTIONS EQUIMOLECULAIRES DANS LA PLETHORE AQUEUSE EXPERIMENTALE]
Maurice Chiray, L. Justin-Besancon, Charles Debray, and Maurice Lacour Sep. 1964 8 p refs Transl. into ENGLISH from Bull. Acad. Med. (Paris), v. 121, no. 11, 1939 p 416–421
(NASA-TT-F-9108) OTS: $1.00 fs; $0.50 mf

The methods used to produce water intoxication and the principal symptoms observed are briefly presented. Rabbits

and dogs were subjected to water intoxication from both distilled and Vichy water. In the rabbits the fatal intravenous dose per kilogram of body weight rose from 69 cc in the case of distilled water to 672 cc for Vichy water; when the gastric route to intoxication was used, the dose rose from 281 cc to 1314 cc, respectively. In the dogs the dose rose from 117 (distilled water) to 500 cc (Vichy water) when the intravenous method of inducing intoxication was used. From the results, it is concluded that the biological properties of water affect appreciably the results obtained in experimental aqueous plethora, and the qualitative factor must be placed among the causes of water intoxication (i.e., the quantity of liquid introduced and its molecular concentration must be considered equally). P.V.E.

N64-33393* National Aeronautics and Space Administration, Washington, D.C.

DISTURBANCE OF OSMOTIC TISSUE REGULATION IN WATER INTOXICATION [DIE STORUNG DER OSMOREGULATION DER GEWEBE BEI DER WASSERVERGIFTUNG]

Paul Gomori and Stephan Molnar Sep. 1964 10 p refs Transl. into ENGLISH from Arch. Exp. Path. Pharmak. (Leipzig), v. 167, 1932 p 459–468

(NASA-TT-F-9110) OTS: $1.00 fs; $0.50 mf

Experimental work of Kerpel–Fronius and Leovey is discussed briefly. Rowntree's conclusion, that it is not the amount of water administered, but the quantity assimilated that is decisive, was cited. He further stated that injection of hypertonic sodium chloride solution prevents toxic symptoms or reverse existing intoxication. This paper reports experiments done on rabbits to determine whether osmotic tissue concentration has a lower limiting value beyond which, in the opposite direction, vital functions are inhibited. The lower viability threshold of osmotic tissue concentration corresponds to that of the 0.60° C freezing point depression (measured by Sabbatini's method) occurring in the brain, liver, and muscle. The conclusion is justified that osmotic tissue concentration has a strictly circumscribed lower threshold value. In water intoxication the animals do not die of increased intracranial pressure, but from severe disturbances in osmotic tissue regulation. E.C.

N64-33394* National Aeronautics and Space Administration, Washington, D.C.

THE EFFECT ON THE ORGANISM OF THE INTRODUCTION OF LARGE QUANTITIES OF WATER [UBER DIE WIRKUNG DER ZUFUHR GROSSER WASSERMENGEN AUF DEN ORGANISMUS]

Kunstmann Sep. 1964 20 p refs Transl. into ENGLISH from Arch. Exptl. Pathol. Pharmakol. (Berlin), v. 170, 1933 p 701–718

(NASA-TT-F-9111) OTS: $1.00 fs; $0.50 mf

With intake of very large quantities of liquid over long periods (127 days), a large sodium chloride loss took place in the organism without loss of water. There is no increased nitrogen elimination. The molar concentration of the blood increases, as does that of sodium chloride in the serum. An increased craving for liquid appears and remains after the end of the test. This increased craving for liquid appears to be conditioned by the loss of sodium chloride. In the course of the test a disturbance of the sodium chloride elimination was established that was noticeable both in the thirst test and with sodium chloride loading. This disturbance does not lie in a change in the kidney function, but depends on the chlorine impoverishment of the organism. Author

N64-33395* National Aeronautics and Space Administration, Washington, D.C.

WATER AND INORGANIC METABOLISM DURING INSULIN TREATMENT OF DIABETICS. STUDIES IN INSULIN EDEMA [UBER DEN WASSER- UND MINERAL STOFFWECHSEL WAHREND DER INSULINBEHANDLUNG DER DIABETIKER. STUDIEN UBER DAS INSULINODEM]

Eskil Kylin Sep. 1964 11 p refs Transl. into ENGLISH from Z. Ges. Exptl. Med. (Heidelberg), v. 63, 1928 p 606–615

(NASA-TT-F-9112) OTS: $1.00 fs; $0.50 mf

During insulin treatment of diabetics the following situation exists: (1) Water retention is particularly evident during the first days of insulin treatment. Later, the water can be flushed out even during insulin treatment. After its discontinuance the retained water is again eliminated. (2) Both blood thickening and blood thinning can be found during the first days of insulin treatment. (3) During insulin treatment the blood calcium level drops, and the blood sodium level rises. The potassium level does not seem to be affected uniformly. (4) During the water-retention phase, urine excretion of sodium and chlorine is reduced. Chlorine and sodium content in the urine increases during flushing of the retained water. Sodium secretion is much greater than that of chlorine. Author

N64-33396* National Aeronautics and Space Administration, Washington, D.C.

THE ASSIMILATION OF LARGE SUDDENLY INGESTED QUANTITIES OF LIQUID [DIE BEWALTIGUNG EINMALIG ZUGEFUHRTER GROSSER FLUSSIGKEITSMENGEN]

F. Reiche Oct. 1964 9 p Transl. into ENGLISH from Med. Klin. (Munich), v. 27, no. 10, 1931 p 347–349

(NASA-TT-F-9114) OTS: $1.00 fs; $0.50 mf

Experimental data are presented in an attempt to evaluate the physiological effects of sudden ingestion of large quantities of water. Preabsorptive values and determinations of water concentration of the blood, as well as of chlorides and urea were made. Four groups were studied to determine to what extent copious doses of liquid might affect the heart though an increase in blood water content and, thus, in blood volume. E.C.

N64-33397* National Aeronautics and Space Administration, Washington, D.C.

WATER INTOXICATION AND WATER DIURESIS IN ADRENAL INSUFFICIENCY AND THE SIGNIFICANCE OF THE ADRENAL GLAND IN OSMOREGULATION ["WATER INTOXICATION" UND WASSERDIURESE BEI DER NEBENNIERENINSUFFIZIENZ; DIE BEDEUTUNG DER NEBENNIERE FUR DIE OSMOREGULATION]

R. Rigler Sep. 1964 4 p refs Transl. into ENGLISH from Klin. Wochschr., v. 14, no. 7, 1935 p 227–228

(NASA-TT-F-9115) OTS: $1.00 fs; $0.50 mf

Experiments carried out on adult rabbits, rats, and mice, whose adrenal glands in some cases had been removed, are described. Results reported include a marked increase in water excretion in the animals without adrenal glands when charged with triple hypertonic salt solution, the osmotic ineffectiveness of glycol after absorption, and the evident renal insufficiency in mice with absent adrenal glands and an overcharge of water. D.E.W.

N64-33398* National Aeronautics and Space Administration, Washington, D.C.

EFFECT OF COPIOUS WATER INTAKE ON THE ORGANISM [UBER DIE WIRKUNG DER AUFNAHME GROSSER WASSERMENGEN AUF DEN ORGANISMUS]

Herman Strauss Sep. 1964 9 p refs Transl. into ENGLISH from Klin. Wochschr. (Berlin), v. 1, no. 26, 1922 p 1302–1305

(NASA-TT-F-9116) OTS: $1.00 fs; $0.50 mf

The kidneys perform according to the intake. After fluid intake decreases, urine volume immediately drops. In this connection renal water secretion can occasionally be temporarily increased. Increased sodium-chloride secretion occurs. Occasionally this results in the elevation in osmotic blood pressure emphasized by Veil. During the increased water intake, blood thinning and considerable anemia appear, and outlast the drinking period. Manifestations of water impoverishment of the body, which would permit comparison with the polydipsia of diabetes insipidus, are lacking. Author

N64-33399* National Aeronautics and Space Administration, Washington, D.C.

PHYSIOPATHOLOGY OF WATER AND SALT METABOLISM AND FLUID REGIMEN OF WORKERS IN OVERHEATED INSTALLATIONS [DIE PATHOPHYSIOLOGIE DES WASSER- UND SALZSTOFFWECHSELS BEI ARBEITERN IN UBERHITZTEN WERKSTATTEN UND DAS TRINKREGIME]

A. Raschewskaja Sep. 1964 13 p refs Transl. into ENGLISH from Arch. Gewerbepath. Gewerbehyg. (Berlin), v. 3, 1932 p 830–839

(NASA-TT-F-9120) OTS: $1.00 fs; $0.50 mf

The mechanism of NaCl deprivation is explained by laboratory tests as blood-thickening concurring simultaneously with the absolute and percentile decrease of natrium chloride in the body fluids. Some case samples are observed. The displacements in the water–salt exchange were verified by tests for polyglobulia, elevated hemoglobin content, leucocytosis, sharply elevated protein content, increase in viscosity, and in the blood calcium and sugar content. The importance of introducing salt at regular intervals into the fluid regimen during work in an overheated room is pointed out. G.G.

N64-33400* National Aeronautics and Space Administration, Washington, D.C.

BIOCHEMICAL CHARACTERISTICS OF ECLAMPTIC CONVULSIONS AND EXPERIMENTAL REPRODUCTION OF ECLAMPTIC INTOXICATION [LES CARACTERISTIQUES BIOCHIMIQUES DES CONVULSIONS DE L'ECLAMPSIE ET LA REPRODUCTION EXPERIMENTALE DE L'INTOYICATION ECLAMPTIQUE]

J. L. Wodon (Brussels U.) Sep. 1964 11 p refs Transl. into ENGLISH from Rev. Franc. Gynecol. Obstet. (Paris), v. 29, 1934 p 863–872

(NASA-TT-F-9121) OTS: $1.00 fs; $0.50 mf

Values of pH of the blood and of the alkaline reserve at and shortly after delivery are discussed along with a graph for both normal primiparas and eclamptics. The statement that eclampsia is a posterior pituitoxicosis is examined, and experiments on dogs are described. The dogs were treated with excesses of water alone, to produce water intoxication, and with water excesses in addition to IM injections of posterior pituitary extract. Convulsive reactions are described along with the accompanying pH and alkaline reserve changes. Because of several differences in the blood condition in human eclamptics, the experimental results are stated to constitute an objection to the idea that eclampsia is a simple water intoxication or an intoxication caused by a posterior pituitary-secretion product. D.E.W.

N64-33401* National Aeronautics and Space Administration, Washington, D.C.

WATER INTOXICATION [UBER WASSERINTOXICATION]

M. Yoshida Sep. 1964 8 p refs Transl. into ENGLISH from Japan Med. World, v. 9, no. 11, 1929 p 335–338

(NASA-TT-F-9125) OTS: $1.00 fs; $0.50 mf

The results of some water intoxication experiments are presented. In the experiments with rabbits, 50 cc of water for each kilogram of body weight were introduced directly into the stomach by gastric tube every half hour. The experiments investigated the following: erythrocyte and hemoglobin resistance; the sedimentation rate of the erythrocytes; the carbon dioxide content of the blood plasma; the H-ion concentration of the blood plasma; the percent of oxygen saturation of hemoglobin; the anatomical and histological changes in the internal organs; hemoglobinemia; and the causes of death. P.V.E.

N64-33402* National Aeronautics and Space Administration, Washington, D.C.

DANGER CAUSED BY RADIATION IN THE BEAMS AND BEAM ZONES OF THE SYNCHROCYCLOTRON [DANGERS DUS AUX RADIATIONS DANS LES FAISCEAUX ET LES ZONES DE FAISCEAUX AU SYNCHROCYCLOTRON]

J. Baarli Oct. 1964 6 p Transl. into ENGLISH from the Report of the MSC (Synchrocyclotron Machine) Meeting, 21 Jun. 1963

(NASA-TT-F-9136) OTS: $1.00 fs; $0.50 mf

The danger caused by synchrocyclotron radiations varies with the nature of the beams' their intensities, particle energies, and the extent of scattering. The biological effects and damage due to radiations are discussed, and dose limits are defined. The maximum permissible particle flux is given for various regions in the proton and neutron rooms for 600-MeV protons, 400-MeV neutrons, 50 MeV π^--mesons, and μmesons. D.S.G.

N64-33407* National Aeronautics and Space Administration, Washington, D.C.

ARTIFICIAL FOOD PRODUCTS AND ASTRONAUTICS [SZTUCZNE SRODKI SPOZYWCZE I ASTRONAUTYKA]

Ignacy Grundland Oct. 1964 17 p refs Transl. into ENGLISH from Astronautyka (Warsaw), v. 6, May 1963 p 21–24

(NASA-TT-F-9146) OTS: $1.00 fs; $0.50 mf

The energy requirements of the individual and of the Earth's population are analyzed in relation to both the available food supply and the ultimate sources of the solar energy that is transformed by plants and algae. The requirements and productivity of photosynthesis are discussed, along with the degradative processes that complete the cycle, and the possible uses of algae are described, with special attention to the characteristics of *Chlorella pyrenoidosa* and *scenedesmus*. It is pointed out that chemical synthesis of foodstuffs may well become important, as a supplement to photosynthesis, not only for space exploration but to feed the Earth's burgeoning population. Author

N64-33408* National Aeronautics and Space Administration, Washington, D.C.

A STUDY OF THE MECHANISM OF THE PAIRWISE ACTIVITY OF THE VESTIBULAR APPARATUS [K IZUCHENIYU MEKHANIZMA PARNOY RABOTY VESTIBULYARNOGO APPARATA]

G. I. Gorgiladze Oct. 1964 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 2, 1964 p 488–491

(NASA-TT-F-9147) OTS: $1.00 fs; $0.50 mf

Electrophysiological techniques are used to study the mechanism of action of the vestibular apparatus, and the reciprocal interconnections between the semicircular canals and the vestibular nuclei in the medulla oblongata. Electrocorticograms

recorded in curarized cats showed that cathode polarization of the ipsilateral labyrinth increased the activity of most vestibular neurons, as did anode polarization of the contralateral labyrinth. Further experiments indicate that the block in vestibular afferentation preventing EEG changes during equal polarization of both labyrinths is localized in the vestibular nuclei themselves and not in the reticular formation. The usual reciprocity between the neurons of the vestibular nuclei on the right and left sides, which is increased by binaural polarization, is disrupted by equal polarization in three different ways. These three possible mechanisms are outlined, and a schematic representation of the interconnections between the vestibular nuclei is proposed. Author

N64-33452* Minnesota U., Minneapolis Medical School
17-KETOSTEROID AND VOLUME OF HUMAN URINE
Franz Halberg and Christian Hamburger Repr. from Minn. Med., v. 47, Aug. 1964 p 916–925 refs
(Grants NsG-517; PHS-5-K6-GM-13,981; PHS-NB-04531-02; PHS-C-4359(C4); Am. Cancer Soc.-E-155E)

Changes in human 17-ketosteroid excretion with a frequency of 1 cycle per week were found in long and reliable series of data. The analyses of a relatively large quantity of information were speedily and accurately accomplished by electronic computer. The physiologic changes detected by complex numerical operations are not readily apparent from inspection of the data. The changes may be called *near* rhythms. Their regularity compares unfavorably with that of any well-known physiologic rhythm. The amplitude of these *near* rhythms is small. Their statistical significance is high, and their biologic importance is now amenable to study. Author

N64-33453* Texas U., Dallas Southwestern Medical School
GRAVITY, RADIATION AND GROWTH
P. O'B. Montgomery, Eugene Rosenblum, and Betty Stapp Repr. from Aerospace Med., v. 35, no. 8, Aug. 1964 p 731–733 refs
(Grant NsG-210-63; Contract AT-(40-1)-2478)

Phage-free *E. coli* B cells were exposed to continuous ionizing radiation from a cobalt-60 source that delivered 55.8 R per hour. Cells so treated show a depression of their growth curves when compared to unirradiated control cells. Ultrastructural observations indicate that these irradiated cells continue to enlarge despite their failure to divide. This enlargement involves the entire cell and its intracellular ultrastructural components. A comparison of these effects of X-radiation with the effects of increased gravity on these cells was made. It is apparent that increased gravity and increased X-radiation produce similar disturbances in the growth curves and in ultrastructural characteristics of *E. coli* B cells. The possibility that these alterations may be of a genetic nature is considered. Author

N64-33456* Rochester U., N.Y.
ENHANCEMENT OF THE PHOTOSYNTHESIS OF *CHLORELLA PYRENOIDOSA* AS A FUNCTION OF FAR-RED AND SHORT-WAVE ILLUMINATIONS
T. T. Bannister and M. J. Vrooman Repr. from Plant Physiol., v. 39, no. 4, Jul. 1964 p 622–629 refs
(Grant NsG-(T)-73)

Both E (the ratio of the rate of photosynthesis supported by far red in the presence of short waves to the rate supported by far red in the absence of short waves) and D (the excess photosynthesis rate generated in enhancement) were characterized as functions of far red and short wave illuminations. By reference to respiratory and saturated photosynthetic rates, the functions *E* and *D* were related to the illumination curve of photosynthesis. The magnitude of *D*, which reached values as high as 0.04 of saturated rate, and the fact that *D* increased with illumination up to illuminations giving approximately 30% of saturated rate, demonstrated clearly that enhancement is photosynthetic and not due to light-induced respiratory inhibitions. The essential characteristics of the observed dependences of *E* and *D* on illumination are in accord with both the spill-over and separate-package hypotheses of enhancement, with the modifications that the distribution of short-wave quanta between the photoreactions is a continuous function of illumination, and light saturation of photosynthesis is taken into account. Author

N64-33486 Joint Publications Research Service, Washington, D.C.
PROBLEMS IN HUMAN AND ANIMAL PHYSIOLOGY
20 Oct. 1964 65 p refs Transl. into ENGLISH from Fiziol. Zh., Akad. Nauk Ukr. RSR (Kiev), no. 4, Jul.–Aug. 1964 p 450–458, 460–467, 469–474, 494–499, 508–514, 518–521, 554–557
(JPRS-26990; TT-64-51246) OTS: $3.00

CONTENTS:

1. ELECTRICAL ACTIVITY OF THE NEURONS OF THE VISUAL CORTEX OF THE RABBIT R. R. Velikaya p 1–12 refs

2. SENESCENCE AND ADAPTATION OF THE ORGANISM V.V. Frol'kis p 13–22 refs

3. THE PROBLEM OF THE INTEROCEPTION OF THE TONGUE V. O. Samoylov p 23–30 refs

4. EFFECT OF AN ULTRA-HIGH FREQUENCY FIELD AND CONVECTIONAL HEAT ON THE ESTRUAL CYCLE IN MICE S. F. Gorodetskaya p 31–38 refs

5. THE MECHANISM OF THE BIOLOGICAL ACTION OF ULTRASONIC VIBRATIONS M. I. Gurevich and S. A. Bershteyn 39–51 refs

6. RELATIONS BETWEEN PERIPHERAL MOTOR CHRONAXY AND THE MOBILITY OF THE BASIC NERVE PROCESSES IN THE HUMAN CEREBRAL CORTEX N. V. Kol'chenka p 52–57 refs

7. EFFECT ON THE ORGANISM OF PARTIAL WEIGHTLESSNESS DUE TO SUBMERSION IN WATER V. P. Dudarev and P. V. Beloshitskiy p 58–62 refs

N64-33495 Argentina. Comision Nacional de Energia Atomica, Buenos Aires
INFLUENCE OF THE pH OF THE CULTURE MEDIUM ON THE ABSORPTION OF $C^{14}O_2$ BY THE *CHLORELLA VULGARIS* [INFLUENCIA DEL pH DEL MEDIO DE CULTIVO EN LA ABSORCION DEL $C^{14}O_2$ POR LA *CHLORELLA VULGARIS*]
Leopoldo J. Anghileri 1964 8 p refs In SPANISH *Its* Informe No. 118

The influence of the pH of the culture medium on the development of *Chlorella vulgaris* and the possible variations in the metabolism of C-14 incorporated with CO_2 were studied. The preparation and composition of the medium are described. It is concluded that, under the given experimental conditions, the *Chlorella vulgaris* ceases its development at a pH of 10.0, but is, nevertheless, able to develop at a pH of 3.0. Apparently the *Chlorella vulgaris* is able to metabolize the C-14 present with HCO_3^- or with CO_2, since a high pH the $CO_3^=$ predominates completely. The values of the activity present in the hydrolyzate of proteins, reaching as high as 60%, can be excessively high because of the presence of activity proceeding from the hydrolysis of the cellulose and nonproteinic compounds.
Trans. by D.E.W.

N64-33496 Defence Research Board, Ottawa (Canada)
STUDY OF THE INFLUENCE OF ROTATORY STIMULATION UPON RESPIRATION
Masami Usami Sep. 1964 19 p refs Transl. into ENGLISH from J. Oto-Rhino-Laryngol. Soc. of Japan, v. 65, no. 5, 1962 p 662–671
(T-84-J)

Under rotatory stimulation, a prolonged expiration is seen in most cases. The labyrinthine respiratory changes bear a definite relation to the intensity of stimulation, since with increasing stimulation the latent period tends to shorten and the postrotatory duration tends to be prolonged. The labyrinthine respiratory changes evoked by rotatory stimulation are affected by the autonomic nervous system; generally speaking, under conditions of autonomic imbalance these changes are greater. The labyrinthine respiratory changes mirror the labyrinthine functional state, for when labyrinthine function is unilaterally depressed and the hypofunctional labyrinth is stimulated, the duration of the respiratory changes is shorter than with stimulation of the labyrinth on the intact side. When, simultaneously with the labyrinthine respiratory changes, the nystagmus and turning sensation also are recorded and the relations between the three phenomena are studied, the per-rotatory labyrinthine respiratory changes generally appear earlier than the per-rotatory nystagmus, and their duration is longer. D.E.W.

N64-33507 Princeton U., N.J.
A FIXED EFFORT SCHEDULE OF REINFORCEMENT
Maxwell A. Morfield (Ph.D. Thesis) May 1964 92 p refs
(Contract Nonr-1858(19))
(AD-607325)

The effects on conditioning performance and extinction of a Fixed Effort (FE) schedule of reinforcement were investigated. The major findings reported are that a decrease occurs in reinforcement rate as a function of the increased effort requirement per reinforcement; high effort requirements appear to have an inhibiting effect on effort per response; effort per reinforcement has no effect on resistance to extinction; the variability of effort per response increases significantly during extinction; there is a significant difference between the effort distributions of the differentiation animals and the FE animals; and a correlation was found between the direction and amount of change of effort per response from conditioning to extinction. D.E.W.

N64-33512* National Academy of Sciences—National Research Council, Washington, D.C.
XVI INTERNATIONAL CONGRESS OF ZOOLOGY, WASHINGTON, 20–27 AUGUST 1963. PROCEEDINGS, VOLUME 1: CONTRIBUTED PAPERS
John A. Moore, ed. [1963] 334 p
(Grant NsG-364)
(NASA-CR-59306) OTS: $7.00 fs; $1.50 mf

Papers and abstracts are compiled that were presented at the Congress of Zoology. They comprise invertebrate zoology, the role of ectocrines in interactions of aquatic invertebrates, the biology of cephalopods, mucus in invertebrates, marine zoology, parasitology, vertebrate zoology, paleontology, systematics, zoogeography, ecology, and scientific demonstrations. Papers are presented in various languages, including English, French, Spanish, and Russian. D.E.W.

N64-33513* National Academy of Sciences—National Research Council, Washington, D.C.
XVI INTERNATIONAL CONGRESS OF ZOOLOGY, WASHINGTON, 20–27 AUGUST 1963. PROCEEDINGS, VOLUME 2: CONTRIBUTED PAPERS
John A. Moore, ed. [1963] 348 p
(Grant NsG-364)
(NASA-CR-59307) OTS: $7.00 fs; $1.75 mf

This is a collection of abstracted papers pertaining to "Behavior (invertebrates)"; "Behavior (vertebrates)"; "Physiology"; "Functional Anatomy and Physiology of Molluscs"; "Endocrinology"; "Evolution"; "Genetics"; "Embryology"; and "Cell Biology." G.G.

N64-33514* National Academy of Sciences—National Research Council, Washington, D.C.
XVI INTERNATIONAL CONGRESS OF ZOOLOGY, WASHINGTON, 20–27 AUGUST 1963. PROCEEDINGS, VOLUME 3: SPECIALIZED SYMPOSIA
John A. Moore, ed. [1963] 431 p refs
(Grant NsG-364)
(NASA-CR-59305) OTS: $7.31 fs; $2.00 mf

This report contains a number of abstracts covering the following objectives: "Endocrine Mediation in Social Adjustments of Vertebrates and Invertebrates"; "The Evolution of Endocrine Systems"; "Behavioral Adaptations of Mammals to Environments"; "Invertebrate Chemoreception"; "The Physiology of Echinodermata"; "The Biology of Gnotobiotic Animals"; "Specific Inhibition During Development"; "Nucleo-Cytoplasmic Interrelations"; "Recent Advances in Neuroanatomy"; "Principles and Problems of Functional Morphology"; "Evolution of Higher Levels of Organization"; "Evolution at the Population and Interpopulation Levels"; "The Regulation of Numbers in Natural Populations"; "Recent Advances in Simian Malaria"; and "Scientific Use of Natural Areas." G.G.

N64-33515* National Academy of Sciences—National Research Council, Washington, D.C.
XVI INTERNATIONAL CONGRESS OF ZOOLOGY, WASHINGTON, 20–27 AUG. 1963. PROCEEDINGS, VOLUME 4: SPECIALIZED SYMPOSIA
John A. Moore, ed. [1963] 396 p refs
(Grant NsG-364)
(NASA-CR-59304) OTS: $7.00 fs; $1.75 mf

This report contains a number of papers covering the following objectives: "The Fauna of North America, Its Origin and Unique Composition"; "Mammalian Evolution on the Southern Continents"; "Evolution of Man"; "New Techniques for Systematics"; "Mimicry"; Biology of Blood Protozoa"; "Insect Development and Endocrinology"; "Chromosome Structure and Function"; "The Deep Scattering Layer"; "The Biology of Abyssal Animals"; "Biological Productivity at the Heterothropic Levels"; "Ecological and Evolutionary Aspects of Biological Clocks"; "The Ontogeny of Basic Response Patterns"; and "Animal Navigation." G.G.

N64-33524 Kentucky U., Lexington
THE EFFECTS OF IMMERSION OF THE HAND IN COLD WATER ON DIGITAL BLOOD FLOW
A. C. L. Hsieh, T. Nagasaka, and L. D. Carlson Fort Wainwright, Alaska, AFSC, Arctic Aeromed. Lab., Mar. 1964 14 p refs
(Contract AF 41(657)-335)
(AAL-TDR-63-35; AD-607603)

The temperatures of the tip of the middle fingers (T_s) of 9 comfortably warm subjects was recorded during immersion of all the fingers of one hand in a 27-liter bath containing slowly stirred water at temperatures ranging from 4.6° to 40° C (T_w). Blood flow (F = ml/cm^2/min) was estimated from the average T_s for the last 15 minutes of a 20-minute period, and T_w and body temperature (T_b) by using the equation $F = 1087 \times K(T_s - T_w)$, where K = 0.0134 kcal/cm^2/min/°C. The increase in F per °C reduction in T_w below 10°C was 0.16 ±0.077 ($P < 0.05$). This value gives a measure of the vasodilatation occasioned

by immersion in water below 10° C. The sample regression equation of F on T_w was $F = 4.1 - 0.16\,T_w \pm 0.17$, where $n = 27$ and the range of T_w = 4.6° to 10° C. This method of estimating blood flow at several levels of T_w describes more fully the peripheral circulatory response to cold than methods in which only one level of T_w is used. Author

N64-33570 Naval School of Aviation Medicine, Pensacola, Fla.
THE EVALUATION OF PHYSIOLOGICAL SYNCOPE IN AVIATION PERSONNEL
Laurence H. Blackburn, Jr. 1 Jul. 1964 22 p refs
(Rept.-16; AD-449817)

Evaluation of syncope in aviation personnel frequently fails to consider physiological causes or hypersensitive responses to physiological acts. The incidence and causes of these types of syncope are discussed, and the experience with syncope is analyzed. A protocol is formulated for the complete, standardized examination of each episode of syncope, and general principles for the proper disposition of syncopal aviators are developed. Author

N64-33577 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON RADIATION THERAPY
3 Nov. 1964 74 p refs Transl. into ENGLISH from Med. Radiol. (Moscow), v. 9, no. 7, Jul. 1964
(JPRS-27203; TT-64-51458) OTS: $3.00

CONTENTS:

1. DETERMINATION OF CARDIAC VOLUME AND OTHER INDICES OF CENTRAL CARDIAC HEMODYNAMICS WITH THE AID OF RADIOACTIVE KRYPTON (Kr85) F. F. Kaperko p 1–15 refs
2. MECHANISM OF FUNCTIONAL AND MORPHOLOGICAL CHANGES OF THE KIDNEYS IN RATS TREATED WITH UNITHIOL FOR RADIATION SICKNESS (Po210) A. I. Poluboyarinova and V. N. Strel'tsova p 16–25 refs
3. UTILIZATION OF A COMPLEX COBALT COMPOUND (Co-30) DURING GENERAL REACTIONS ACCOMPANYING RADIATION THERAPY D. M. Abdurasulov, A. I. Nikolayev, and G. S. Ikramova p 26–31 refs
4. CORRELATION OF SOME EFFECTS (BLASTOMOGENIC, TUMOFACIENT AND LIFE SHORTENING) DURING THE ACTION OF IONIZING RADIATION R. V. Smirnov p 32–40 refs
5. CLINICAL PECULIARITIES OF ACUTE RADIATION SICKNESS IN MONKEYS PREVIOUSLY IMMUNIZED WITH BCG VACCINE N. V. Rayeva, N. N. Klemparskaya, and I. N. Usacheva p 41–54 refs
6. CHANGES IN THE CARDIOVASCULAR SYSTEM UNDER THE INFLUENCE OF AMINOTHIOLS L. I. Tank and V. I. Kuznetsov p 55–69 refs
7. FOURTH INTERINSTITUTE CONFERENCE ON PROBLEMS OF RADIATION MICROBIOLOGY AND IMMUNOLOGY D. R. Kaulen p 70–76

N64-33578 Joint Publications Research Service, Washington, D.C.
FURTHER EXPERIMENTS ON CHEMOTHERAPY IN THE TREATMENT OF RADIATION SICKNESS
M. A. Tumanyan and A. V. Izvekova 4 Nov. 1964 8 p refs Transl. into ENGLISH from Antibiotiki (Moscow), v. 9, no. 8, Aug. 1964 p 719–722
(JPRS-27220; TT-64-51475) OTS: $1.00

This study describes the development of chemotherapy charts for infectious complications of radiation sickness. By the appearance of antibiotic-resistant microflora in irradiated and treated apes, a sharp drop in the effectiveness of the chemotherapy took place. It was concluded that the chemotherapy results depend significantly on the formation of antibiotic-resistant forms of bacteria of the autoflora. The antibiotics phenoxypenicillin, mycerin, monomycin, and also sulfamide phthalazine gave the best results in survival rates of rabbits and rats exposed to lethal radiation doses. G.G.

N64-33582 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
RADIATION AND CHEMICAL PROTECTION
Evgenii Fedorovich Romantsev Nov. 1963 253 p refs Transl. into ENGLISH of the book "Radiatsiya i Khimicheskaya Zashchita" Moscow, Gosatomizdat., 1963 204 p
(AEC-TR-6258) OTS: $6.00

The current status of the problem of protecting organisms from penetrating radiation by using internally administered chemicals is presented. Subjects covered include primary physicochemical processes in the action of radiation, bases of the search for chemical protective agents, radiation and the cellular microstructure, chemical protection of sulfur-containing amino acids and glutathione, prophylactic and antiradiation effects of several specific agents, and chemical protective agents that increase the radioresistance of organisms. D.E.W.

N64-33604 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
CLOSED ECOLOGIES FOR MANNED INTERPLANETARY FLIGHT
J. J. Konikoff Oct. 1963 40 p refs Presented at AIAA Meeting on Eng. Probl. of Manned Interplanet. Exploration, Palo Alto, Calif. 1 Oct. 1963
(R63SD83; AD-423218)

This report describes two ecological systems for the support of man during long-term space flight. The first system uses the methods of physical chemistry to recover water, maintaining oxygen and CO_2 balance from a simplified waste management system. Food is prestored. The second system utilizes the photosynthetic mechanism to produce food with the concomitant balance of oxygen and carbon dioxide. Wastes are disposed of in a modified activated sludge treatment tank that forms one-half of a biochemical fuel cell such that a capability exists for the production of small but significant amounts of electric energy. Author

N64-33662 Istituto di Ricerche Farmacologiche (Mario Negri), Milan (Italy)
ANTISEROTONIN AGENTS First Quarterly Technical Status Report, 1 Feb.–30 Apr. 1964
Silvio Garattini [1964] 15 p refs
(Contract DA-91-591-EUC-3233)
(AD-447846)

Progress in the following studies is briefly discussed: (1) "Effects of Antiserotonin Drugs on Gastrointestinal Propulsion"; (2) "Effect of Drugs on the Bronchoconstriction Produced by Serotonin in Guinea Pigs"; and (3) "Effects of Drugs on the Antidiuretic Effect Produced by Serotonin." P.V.E.

N64-33675 Joint Publications Research Service, Washington, D.C.
POLAROGRAPHY IN MEDICINE AND BIOLOGY
I. T. Shevchenko and V. I. Gorodyskiy 5 Nov. 1964 45 p Transl. into ENGLISH from Polyarografiya v Meditsine i Biologii. (Kiev), 1964 p 5–6; 81–121; 133–134
(JPRS-27237; TT-64-51492) OTS: $2.00

Polarography, based on the principle that current power is proportional to the concentration of electrolytically reacting substances, is convenient for determination of cations, anions, hormones, amino acids, vitamins, and carbohydrates. Since improvement or deterioration in the condition of a patient are reflected in the height of the polarographic wave of blood serum and its protein-free filtrate, the polarographic method may be used to follow the course of cancer in patients. The polarographic method is described, and experience using this method in cancer studies over a number of years is documented. M.P.G.

N64-33687* National Academy of Sciences—National Research Council, Washington, D.C.
XVI INTERNATIONAL CONGRESS OF ZOOLOGY, WASHINGTON, 20–27 AUGUST 1963. VOLUME 7: SCIENCE AND MAN SYMPOSIUM, NATURE, MAN AND PESTICIDES
John A. Moore, ed. 1964 50 p refs
(Grant NsG-364)
(NASA-CR-59303) OTS: $2.00 fs; $0.50 mf

The symposium discussed the following topics: (1) "Man, Food and Insects as an Ecological Problem"; (2) "Opportunities for the Development of Specific Methods of Insect Control"; (3) "Effect of Pesticides on Human Health"; and (4) "The Validity of Ecological Models." P.V.E.

N64-33854 Joint Publications Research Service, Washington, D.C.
DISTRIBUTION OF RADIOACTIVE CALCIUM AND ITS EXCRETION FROM THE BODIES OF HEALTHY AND LEAD-POISONED ANIMALS
K. K. Makashev and L. V. Kazachenko 13 Oct. 1964 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk Kazakh. SSR (Alma-Ata), no. 1, 1964 p 50–55
(JPRS-26888; TT-64-51145) OTS: $1.00

Conclusions state that the poisoned rats excreted less radioactive calcium (^{45}Ca) than the rats of the control series; that the lower ^{45}Ca elimination in the poisoned rats was attributable to the feces, since the same quantity of calcium was excreted in the urine in the normal and poisoned animals; and that the rate at which ^{45}Ca accumulated in the bone tissue was considerably higher in the poisoned rats. D.E.W.

N64-33875 Joint Publications Research Service, Washington, D.C.
EFFECT OF RADIATION ON NUCLEIC ACIDS
5 Nov. 1964 17 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 157, no. 4, 1964 p 975–981
(JPRS-27239; TT-64-51494) OTS: $1.00

This is a study of the relationship between the radiation resistance and the content of nucleic acids in *Escherichia coli* and in some of their variants that are resistant to different antibiotics. The sensitivity to X-rays was determined from dose curves that were exponential for all of the variants. The nucleic acid content was determined in the dry bacterial mass and calculated per cell. It was found that the increased radiation resistance was accompanied by an increased content in DNA and RNA. A positive relation between radiation resistance and nucleic acid content was established. G.G.

N64-33906* Naval School of Aviation Medicine, Pensacola, Fla.
REDEFINITION OF THE MACULA NEGLECTA IN MAMMALS Report No. 97
Makoto Igarashi and Samuel Lansdon 30 Jul. 1964 23 p refs Joint report with NASA
(NASA Order R-93)
(NASA-CR-59374) OTS: $1.00 fs; $0.50 mf

The rudimentary vestibular sensory end organ at the junctions of the utricle and semicircular canals was investigated in 70 mammalian ears, including those of man. The papillary or smooth epithelial thickening at the junction of the posterior crus of the lateral semicircular canal and the inferior utricular sinus, which has been called macula neglecta by many previous investigators, was observed in almost all of the human and dog specimens and in 25% of the squirrel monkeys. The term "epithelial mound of lateroposterior utricular fold" is recommended. In the cat and dog ears examined, but in none of the other mammals, the epithelial structure on the anterior medial wall of the inferior utricular sinus exhibited in almost all instances a stroma, blood supply, nerve supply, and specialized sensory epithelium. For this reason, the term "sensura neglecta" is suggested as an adequate one. Author

N64-33924* National Academy of Sciences—National Research Council, Washington, D.C.
XVI INTERNATIONAL CONGRESS OF ZOOLOGY, WASHINGTON, 20–27 AUGUST 1963. VOLUME 8: THE PROTECTION OF VANISHING SPECIES
John A. Moore, ed. 1964 45 p refs
(Grant NsG-364)
(NASA-CR-59027) OTS: $2.00 fs; $0.50 mf

CONTENTS:

1. EXTINCT, RARE AND ENDANGERED AMERICAN FRESHWATER FISHES Robert Rush Miller (Michigan U.) p 4–16 refs
2. THREATENED SPECIES OF MAMMALS IN NORTH AMERICA Ian McTaggart Cowan (Brit. Columbia U.) p 17–21
3. THREATENED BIRDS OF THE NEW WORLD S. Dillon Ripley (Smithsonian Inst.) p 22–24
4. VANISHING BIRDS OF THE OLD WORLD Jean Dorst (Museum Nat. d'Hist. Nat.) p 25–28
5. RARE AND THREATENED MAMMALS IN AFRICA Thane Riney (FAO/IUCN) p 29–32
6. VANISHING MAMMALS OF ASIA Harold J. Coolidge p 33–36

N64-33943 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MATERIALS ON THE TOXICOLOGY OF RADIOACTIVE SUBSTANCES
V. F. Zhuravlev and I. K. Petrovich 21 Sep. 1964 10 p Transl. into ENGLISH from Med. Radiol. (Moscow), v. 6, no. 12, 1963 p 81–83
(FTD-TT-64-599/1; AD-607120)

The introduction to a volume of 15 collected papers on the toxicology of Fe^{59} gives a brief critical review of the results reported in each of the papers. Topics covered include the effects of radioactive iron on the hemapoesis system, carbohydrate metabolism, cardiovascular system, central nervous system, and the morphology of organs and tissues. The individual papers are not included. M.P.G.

N64-33957 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM PRIRODA (NATURE), NO. 6, 1964
20 Oct. 1964 46 p Transl. into ENGLISH from Priroda (Moscow), no. 6, 1964 p 29–32, 56–64, 89–95, 119–124
(JPRS-26991; TT-64-51247) OTS: $2.00

CONTENTS:

1. THE ORIGIN AND EVOLUTION OF METABOLISM A. I. Oparin p 1–7
2. CLASSIFICATION AND SYSTEMATIZATION OF SCIENCE D. M. Troshin p 8–21

3. HYDRAULIC MEANS OF LOCOMOTION IN ANIMALS L. A. Zenkevich and V. S. Muraveyskaya p 22–32
4. SCIENTIFIC WRITINGS ABOUT THE UNIVERSE S. I. Smuglyy p 33–36
5. INTERACTION OF SCIENCES IN THE STUDY OF THE EARTH K. P. Florenskiy p 37–38
6. BOOK ON ARTS REVIEWED D. V. Panfilov p 39–41
7. EVOLUTION AND FRONTIERS OF THE PERIODIC SYSTEM Yu. Ya. Yakoulev p 42–44

N64-33961 Joint Publications Research Service, Washington, D.C.
IMMUNOLOGY RESEARCH IN THE USSR
9 Nov. 1964 30 p refs Transl. into ENGLISH from Zh. Mikrobiol. Epidemiol. i Immunobiol. (Moscow), v. 41, no. 9, 1964 p 76–80, 104–112, 144
(JPRS-27281; TT-64-51537) OTS: $2.00

CONTENTS:
1. THE EFFECT OF IRRADIATION ON THE PREVENTIVE PROPERTIES OF SERA FROM GUINEA-PIGS IMMUNIZED WITH LIVING BRUCELLA VACCINE Z. V. Shevtsova p 1–8 refs
2. THE STABILITY OF BIOLOGICAL PROPERTIES OF STRAIN STI-1 ANTHRAX VACCINE N. N. Ginsberg, R. A. Saltykov, and V. R. Arkhipova p 9–14 refs
3. WAYS TO IMPROVE THE QUALITY OF PROPHYLACTIC AND THERAPEUTIC PREPARATIONS A. T. Kravchenko p 15–25
4. IMMUNITY TO SMALLPOX IN VACCINATED CHILDREN FOUR AND EIGHT YEARS OF AGE I. M. Suslov p 26–27

N64-33970 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MULTIPLE ELECTRODE IMPLANTATION INTO SUBCORTICAL STRUCTURES OF THE HUMAN BRAIN
K. V. Grachev 25 Mar. 1964 10 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 49, no. 9, 1963 p 1122–1125
(FTD-TT-63-1119/1+2+4; AD-435998)

Development and improvement of the methods used in implanting electrodes in the human brain are discussed. A multiple deep electrode mounted in the form of a bundle is described. The electrode "needle" (bundle) consists of several parallel, insulated wires glued together. When wire of 100μ diameter is used the diameter of a 6-electrode bundle is about 0.4 mm. The most suitable length of the electrode bundle was found to be about 220 mm. The stereotaxic device developed for use with the electrode bundle consists of two parts—a base and a right angle with a tilting frame. A pinion with a holder for the needle guide moves along the arc of the tilting frame. The tilting frame and the pinion can be fixed in any position, independent of each other, which allows the electrode to be inserted in any direction. P.V.E.

N64-33974 Joint Publications Research Service, Washington, D.C.
THE ROLE OF CONDITIONAL SIGNALIZATION IN THE SPATIAL ANALYSIS IN BATS
A. I. Konstantinov 9 Nov. 1964 15 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 14, no. 4, Jul.–Aug. 1964 p 701–706
(JPRS-27285; TT-64-51541) OTS: $1.00

The mechanism of time relations and analyzers in the formation of spatial orientation in bats is discussed. A conditioned reflex to the feedbox location was established. Through shifting of the feedbox position, a rearrangement of the nervous processes was initiated and was observed by the delaying-time differential. It was concluded that a directed behavior in bats is always a result of elaboration of the reaction of the conditioned-reflex character. G.G.

N64-33975 Joint Publications Research Service, Washington, D.C.
PROBLEMS IN THE MECHANICS OF RADIATION INJURY
A. D. Zurabashvili and B. R. Naneishvili 9 Nov. 1964 9 p Transl. into ENGLISH from the book "Voprosy Patoarkhitektoniki Luchevogo Porazheniya" Tbilisi, Publ. House of Acad. of Sci. GSSR., 1962 p 58–66
(JPRS-27289; TT-64-51545) OTS: $1.00

This is a study of the pathological aspects of nervous tissue injury due to deep X-ray therapy. The brain substance was found to be fairly sensitive to ionizing radiation. The pathological shifts produced in the central nervous system were the results of hemodynamic disturbances, and also the direct effect of penetrating radiation on the cerebrospinal system. The different degrees of injury of the central nervous system sections depended on their functional significance, levels of development, and phylogenetic formation. G.G.

N64-33993 Illinois U., Urbana
TO DETERMINE THE EFFECT OF IRRADIATION UPON THE WHOLESOMENESS OF FOOD Progress Report, Mar.–Sep. 1962
Elwood F. Reber, Om P. Malhotra, and Horace W. Norton [1962] 129 p refs
(Contract DA-49-007-MD-72800)
(PR-14; AD-401022)

A total of 1030 rats of the Sprague–Dawley and Holtzman strains were used to investigate the effects of estrogen, testosterone, vitamin K, methionine, and strain of rat on the incidence of hemorrhagic disease in adult and weanling rats fed irradiated beef (5.58 megarad). Results are reported in terms of each individual effect, and in terms of cross influences and masking among the various factors. D.E.W.

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 05 Auxiliary Systems.

N64-32692 Army Materials Research Agency, Watertown, Mass.
PROCEEDINGS OF THE ROCKET NOZZLE MATERIALS SYMPOSIUM
Dec. 1963 148 p refs Symp. held at Watertown, Mass., 12 Jun. 1962
(AMRA-MS-63-06; AD-449603)

CONTENTS:

SECTION I: ROCKET NOZZLE EROSION AND MATERIALS RESEARCH
1. SOME OBSERVATIONS ON SIMILITUDE IN THE TESTING OF SOLID PROPELLANT ROCKET NOZZLES S. W. Gouse, Jr. p 3–9 ref (See N64-32693 24-17)

2. INVESTIGATION OF THE EFFECTS OF SIMULATION AND SCALE-UP ON PERFORMANCE OF ROCKET NOZZLE MATERIALS L. Jablansky (Picatinny Arsenal) p 10–28 refs (See N64-32694 24-17)

3. MATERIALS AND COOLANT SYSTEMS FOR SOLID PROPELLANT ROCKET NOZZLES P. Wachs (ARDE-Portland) p 29–56 refs (See N64-32695 24-13)

4. NOZZLE MATERIAL DEVELOPMENT AT THE U.S. ARMY MISSILE COMMAND V. A. Nieberlein (Army Missile Command) p 57–62 (See N64-32696 24-17)

SECTION II: REFRACTORY MATERIALS DEVELOPMENT

5. OPTIMIZATION OF ELECTRODEPOSITED HIGH TEMPERATURE PROTECTIVE ROCKET NOZZLE COATINGS J. Huminik, Jr. and E. Goodman (Value Eng. Co.) p 63–70 (See N64-32697 24-17)

6. IMPROVEMENT OF THE USEFULNESS OF PYROLYTIC GRAPHITE IN ROCKET MOTOR APPLICATIONS J. D. Batchelor, E. F. Ford, and E. L. Olcott (Atlantic Res. Corp.) p 71–111 refs

7. DEVELOPMENT OF REFRACTORY MATERIALS FOR ROCKET MOTOR APPLICATIONS R. Francis (Little, Arthur D.) p 112–128 refs (See N64-32698 24-17)

8. COPPER-COOLED TUNGSTEN FIBER ROCKET NOZZLE MATERIALS N. M. Parikh (ITT Res. Inst.) p 129–142 (See N64-32699 24-18)

N64-32693 Army Materials Research Agency, Watertown, Mass.

SOME OBSERVATIONS ON SIMILITUDE IN THE TESTING OF SOLID PROPELLANT ROCKET NOZZLES

S.W. Gouse, Jr. *In its* Proc. of the Rocket Nozzle Mater. Symp. Dec. 1963 p 3–9 ref (See N64-32692 24-17)

The basic mechanisms of rocket-nozzle deterioration have been considered. The effects of mechanical, chemical, and thermal attack have been discussed both separately and as integral conditions of nozzle failure. A list of independent variables associated with and governing the results of a solid-propellant rocket-nozzle test program is presented. An analysis of the procedure used in choosing a model nozzle is also given. Author

N64-32694 Picatinny Arsenal, Dover, N.J.

INVESTIGATION OF THE EFFECTS OF SIMULATION AND SCALE-UP ON PERFORMANCE OF ROCKET NOZZLE MATERIALS

L. Jablansky *In* Army Mater. Res. Agency Proc. of the Rocket Nozzle Mater. Symp. Dec. 1963 p 10–28 refs (See N64-32692 24-17)

A literature study and series of field trips were made to compile information on factors affecting the performance of rocket nozzle materials and means of simulating these factors under controlled conditions. It was found that most rocket nozzle failures occur as a result of corrosion, erosion, thermal shock, mechanical shock, or some combination of these. It was also determined that the important physical and chemical factors responsible for these effects are chemical composition of exhaust gas, heat flux, and shear stress. An experimental program was initiated to determine how effectively a liquid rocket engine could simulate a solid rocket motor, with respect to matching the important physical and chemical factors in the nozzle region. Author

N64-32696 Army Missile Command, Huntsville, Ala.

NOZZLE MATERIAL DEVELOPMENT AT THE U.S. ARMY MISSILE COMMAND

Vernon A. Nieberlein *In* Army Mater. Res. Agency Proc. of the Rocket Nozzle Mater. Symp. Dec. 1963 p 57–62 (See N64-32692 24-17)

The process for vapor deposition of tungsten on graphite has been extended to the application of tungsten to the interior of a Nike-Zeus blast tube. Several designs have been made for vapor plating a lining of TaC onto graphite for nozzle applications. Differences in thermal expansion have caused these designs to leak at high temperature. The centrifugal casting of tungsten into a nozzle shape has been started. Basis for the process is a thermite reaction. Pressure traces have been made, and one centrifuge experiment was performed. Author

N64-32697 Value Engineering Co., Alexandria, Va.

OPTIMIZATION OF ELECTRODEPOSITED HIGH TEMPERATURE PROTECTIVE ROCKET NOZZLE COATINGS

Joh Huminik, Jr. and Elliot Goodman *In* Army Mater. Res. Agency Proc. of the Rocket Nozzle Mater. Symp. Dec. 1963 p 63–70 (See N64-32692 24-17)

(Contract DA-36-034-ORD-3099)

Progress on the development of an electrodeposited cermet coating is reported, and includes the development of a new heat-treating process. The use of a laboratory rocket motor for test firing small rocket nozzles is also discussed. Data gathered during these test firings are presented and explained. Author

N64-32698 Little (Arthur D.) Inc., Cambridge, Mass.

DEVELOPMENT OF REFRACTORY MATERIALS FOR ROCKET MOTOR APPLICATIONS

Ronald Francis *In* Army Mater. Res. Agency Proc. of the Rocket Nozzle Mater. Symp. Dec. 1963 p 112–128 refs (See N64-32692 24-17)

(Contract DA-19-020-ORD-5490)

Massive coherent deposits of carbon and the isostructural boron nitride have been prepared by the pyrolysis of methane, propane, benzene, and B-trichloroborazole on graphite substrates heated at 1300° to 2500° C under a variety of experimental conditions. A particularly hard form of the material that can be prepared from the benzene source is described. Property dependence upon synthetic variables, the effect on graphitization by heat treatment, and principal comparisons of the two materials are considered in detail. Author

N64-32768* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

FABRICATION

Austin F. Reader, Edward F. Baehr, Walter E. Russell, and George Tulisiak *In its* Conf. on New Technol. 1964 p 5–32 (See N64-32767 24-01) GPO: $1.00

Some of the fabrication techniques and equipment utilized by the NASA Lewis Research Center, other NASA centers, the Department of Defense, and the aerospace industry in solving the problems generated by the exact and demanding field of space-age hardware manufacture are described. Techniques discussed include development of materials with improved fabrication characteristics, metal forming (high-energy-rate and high-temperature forming, deposition, and cold working), machining (electric discharge and electrochemical machining, chemical milling, abrasion, and laser processes) and joining (electron-beam welding and furnace brazing). M.P.G.

N64-32769* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

MATERIALS

S. S. Manson, G. Mervin Ault, Jack B. Esgar, Robert W. Hall, and John L. Shannon, Jr. *In its* Conf. on New Technol. 1964 p 33–63 (See N64-32767 24-01) GPO: $1.00

Recent progress in the materials field is covered under the following topics: brittle fracture problems, fracture mechanics, fatigue, high-strength materials, liners for glass-fiber-reinforced pressure vessels, fiber metallurgy, beryllium, titanium alloys, creep, nickel-base alloys, cobalt-base alloys, dispersion-strengthened materials, refractory materials, tungsten-alloys program, oxidation protection, and pyrolytic graphite. M.P.G.

N64-32771* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LUBRICATION IN DIFFICULT ENVIRONMENTS
William J. Anderson *In its* Conf. on New Technol. 1964 p 91–96 (See N64-32767 24-01) GPO: $1.00

The functions of a lubricant are reviewed briefly, and non-conventional lubrication methods are discussed. Methods developed for cryogenic applications include ball-bearing retainers made of slippery or self-lubricating materials, transfer surface films, and the use of small or hollow balls in cryogenic turbomachinery bearings. For the high-temperature range, inorganic solid lubricants and fused coatings are being developed. Bearing materials of improved purity and new forging techniques have also contributed to extending bearing life. Non-space applications of these techniques are suggested. M.P.G.

N64-32812 United Aircraft Corp., East Hartford, Conn. Research Labs.
EXPLORATORY INVESTIGATIONS OF GLASS–METAL COMPOSITE FIBERS Bimonthly Progress Report No. 1, 13 Apr.–13 Jun. 1964
J. E. Cox, R. D. Veltri, and C. E. Shulze 13 Jul. 1964 31 p refs
(Contract NOw-64-0389-f)
(C910242-1; AD-449761)

This report is a summary of preliminary investigation of a process for the production of continuous lengths of 1μ-diam wire. The process involves the casting of molten metal as a core material in a glass capillary as the capillary is continuously formed from glass tubing. To date, beryllium and copper have been given major consideration as the core metals; chromium and aluminum have been given minor attention. Author

N64-32832* Williams (Clyde) and Co., Columbus, Ohio
RELIABILITY AND REDUNDANT CIRCUITRY
P. R. Dennis and Sundarum Seshu Washington, NASA, Oct. 1964 34 p refs
(Contract NASw-778)
(NASA-CR-128) OTS: $1.00

To overcome malfunctions caused by failed parts, redundant (or extra) parts must be used in the system, parts that would be quite unnecessary if no failures ever occurred. The report is not a "textbook" on redundancy theory and applications, but rather pulls together diverse work in the field of redundancy involving both NASA and non-NASA contributions to indicate the state-of-the-art. The references used in the report and listed in its bibliography comprise a cross section of work accomplished in the field of redundancy. They include both report and open literature for the 10-year period 1954 to 1963. Individual references are discussed, their unique contributions are noted, and some comments are made on the validity and practical aspects of the individual works. The report also delineates various types of redundancy and the applications of each type. Author

N64-32876 European Atomic Energy Community, Brussels (Belgium)
SEVENTH GENERAL REPORT ON THE ACTIVITIES OF THE COMMUNITY, MARCH 1963–FEBRUARY 1964, VOLUME I
Mar. 1964 109 p Available from EURATOM: 150 Belg. Fr.

The following aspects of nuclear power and energy are discussed: economic and social affairs; nuclear techniques and the joint research program, promotion of industrial development; health, safety, and biology; resources and facilities; and external relations. G.G.

N64-32877 Boeing Co., Seattle, Wash.
INVESTIGATION OF POSITIVE DISPLACEMENT CRYOGENIC FLUID EXPULSION TECHNIQUES
W. D. Allingham [1964] 127 p refs
(D2-22297)

The purpose of this study is to investigate several concepts for achieving positive expulsion of cryogenic liquids from tanks designed to function in a zero-gravity environment. An experimental evaluation was made of the floating piston and the metal bellows as expulsion devices. Positive expulsion systems using a metal bellows provide a simple and reliable means for expelling cryogenic liquids from tanks in a zero-gravity environment. Bellows expulsion is best suited for oxygen storage systems and to a lesser extent for nitrogen storage. Due to the low critical pressure and liquid density of hydrogen, positive expulsion would be attractive only for relatively short storage periods and high expulsion rates. The expulsion of cryogenic liquids with a floating piston was found impractical because of high seal leakage and the erratic expulsion flow rate caused by excessive friction between the piston seal and cylinder wall. E.C.

N64-32880 Mound Lab., Miamisburg, Ohio
PRODUCTION OF BERYLLIUM-COATED PLASTIC WINDOWS
J. W. Voigt 1 Apr. 1964 17 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1194) OTS: $1.00

A method was developed for mass producing beryllium-coated plastic films to be used as X-ray sensory windows on tandem detection satellites. Formvar plastic was dissolved in chloroform and spread by an automatic applicator on a glass to produce a dry film weighing 20–50 $\mu g/cm^2$. Mounted on 3-inch square frames, the films were vacuum coated on both sides with beryllium, which was vaporized from a disposable boat-shaped tantalum electrode. To prevent film rupture, a slow evacuation and subsequent release of air into the vacuum chamber were required. Finished films were tested for optical density by comparing the intensity attenuation of a light source due to the film with attenuation by standard filters; the maximum allowable light transmission was 10^{-6}. A method was also developed for determining the weight density by the attenuation of alpha rays from a polonium-210 source. This method gave values that were an average 0.5 $\mu g/cm^2$ low for beryllium films weighing up to 60 $\mu g/cm^2$. Author

N64-32888* Sperry Farragut Co., Bristol, Tenn.
DESIGN, DEVELOPMENT, AND FABRICATION OF A REACTION WHEEL UTILIZING A BRUSHLESS DC MOTOR Monthly Technical Progress Report, No. 1, 1–30 Jul. 1964
J. M. Welch 17 Aug. 1964 36 p
(Contract NAS5-9016)
(NASA-CR-58773; Publ.-3100-R429) OTS: $2.00 fs; $0.50 mf

Analytical evaluations have been made of the torquer concept with a rotor that contributes an insignificant portion of the required inertia, and of the ironless motor concept with rotor magnets providing a major portion of the total inertia. A "pancake" motor configuration in the wheel and housing design for use with the torquer was found to be too heavy. The use of extra stator winding in the electronic commutator, for efficiency increase, is described. G.G.

N64-32929 Frankford Arsenal, Philadelphia, Pa.
ULTRASONIC IN-PROCESS INSPECTION OF RESISTANCE SPOT WELDS
George E. Burbank and Wallace D. Taylor Jul. 1964 34 p
(R-1729; AD-449005)

This investigation was concerned with the development and evaluation of an ultrasonic test method for examining resistance spot welds during the fabrication process. The basic approach was tested through the examination of welds in aluminum specimens. Significant developments included the transducer design, which combines the piezoelectric crystals with the welding electrodes, and preparation of an electronic system for photographically recording all ultrasonic signal patterns associated with the fabrication of a single weld. Repeatable ultrasonic signal patterns were obtained indicating the formation of a weld and providing the means for predicting weld strength. Other factors concerning the operation of the welding machine were also evident. Author

N64-32943 Lockheed Missiles and Space Co., Sunnyvale, Calif.
MANUFACTURING RESEARCH INVESTIGATION: PLASMA-TORCH CLEANING OF JOINTS PRIOR TO WELDING—2219 Al Final Report
Vernon F. Martin Oct. 1963 12 p
(MRI-106.04)

The removal of surface films from aluminum prior to welding is a mandatory process. Preweld aluminum cleaning processes, which have proved adequate for many years, are now often ineffective because of longer assembly time cycles, during which parts become contaminated prior to the start of welding. Reports from several sources indicate the feasibility of cleaning aluminum parts in position by the cathodic action of a plasma-arc torch. Author

N64-32960 Naval Ordnance Test Station, China Lake, Calif. Propulsion Development Dept.
THE APPLICATION OF ULTRASONICS TO WIRE DRAWING Quarterly Progress Report, 1 Apr.–30 Jun. 1964
A. T. Robinson, J. C. Connelly, and L. M. Stayton Aug. 1964 7 p ref
(NOTS-TP-3636; TPR-375; AD-606628)

Die welding during drawing of annealed piano wire was alleviated by pickling the wire in a dilute nitric acid solution and using molybdenum disulfide as the lubricant. Temperature rise in the drawn wire between the die and isolator, during ultrasonic radiation, occurs at discrete points along the wire at intervals of approximately 5 inches. The points of maximum heating correspond to the antinodal points of a stationary acoustic wave. Author

N64-32965 Vickers, Inc., Detroit, Mich. Aerospace Div.
INVESTIGATION OF A HIGH SPEED DIRECTLY DRIVEN ENGINE HYDRAULIC PUMP
R. W. Holmes and R. P. Lambeck 2 Oct. 1964 20 p refs
(Contract AF 33(615)-1603)
(QPR-1; AD-449929)

Eight types of pumps were studied and compared on the basis of design and performance compatibility with the contract requirements. The pump type selected for further design and hardware is the orbital pump. Author

N64-32978 Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Labs.
STUDY OF THE FEASIBILITY OF APPLYING ULTRASONIC ENERGY TO THE ROLLING PROCESS FOR SHEET METALS Bimonthly Progress Report, 6 Jun.–6 Aug. 1964
Ronald J. Lanyi and James W. Cunningham [1964] 47 p
(Contract NOw-64-0294-j)
(BMPR-3; AD-448499)

The investigation is confined primarily to the design and performance of a transducerized roll. Data are presented for a brazed full-scale test roll and subsequent test sections, which indicate the acoustic feasibility of constructing an internally transducerized roll that will vibrate at a frequency of 11 kc/sec with a peak-to-peak radial surface displacement of at least 0.12×10^{-3} inches. Additional data on transducerized work pieces of copper and steel are presented. Author

N64-32984 Army Materials Research Agency, Watertown, Mass.
INFRARED BOND DEFECT DETECTION SYSTEM
Otto R. Gericke and Paul E. J. Vogel Sep. 1963 14 p refs
(Contract DA-19-020-ORD-5243)
(AMRA-TR-63-14; AD-421817)

This report describes an experimental investigation of a one-sided infrared method of inspecting bond integrity in laminates of dissimilar materials such as the case, liner, and propellant of missiles. It includes a description of the instrumentation, method of low-level heat injection, and method of detecting and displaying or recording the infrared radiation that varies in magnitude as a function of the bond integrity. Author

N64-33034* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SOLDERING OF ELECTRICAL CONNECTIONS (HIGH RELIABILITY), PROCEDURE FOR
15 Feb. 1963 43 p
(NASA-TM-X-54760; MSFC-PROC-158B) Supersedes MSFC PROC-158A OTS: $2.00 fs; $0.50 mf

This procedure specifies the methods, equipment, and materials that are to be used in soldering electrical connectors for space vehicles. Author

N64-33039* Wheeler Labs., Inc., Smithtown, N.Y.
DEVELOPMENT OF MACROSCOPIC OPTICAL WAVEGUIDE COMPONENTS Progress Report, Aug. 1964
E. Ronald Schineller 16 Sep. 1964 3 p refs
(Contract NASw-888)
(NASA-CR-58870) OTS: $1.00 fs; $0.50 mf

The possibility of constructing a directional coupler from a single sheet of microsheet glass was studied. Experimental testing of two quartz slabs (2 1/2-mils thickness) for use as solid-core waveguides indicated good propagation of low-order modes, and single-mode propagation over limited regions of the slab. A survey of various plastic materials for construction of an all-solid waveguide indicated that methyl methacrylate (lucite, plexiglass) had the best optical properties for a waveguide application. R.L.K.

N64-33043* General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
MEASURED EFFECTS OF THE VARIOUS COMBINATIONS OF NUCLEAR RADIATION, VACUUM, AND CRYOTEMPERATURES ON ENGINEERING MATERIALS. VOLUME II: RADIATION-CRYOTEMPERATURE TESTS Annual Report, 9 Nov. 1962–30 Apr. 1964
E. E. Kerlin and E. T. Smith 1 May 1964 320 p refs
(Contract NAS8-2450)
(NASA-CR-58830; FZK-188-2) OTS: $7.00 fs; $1.75 mf

A series of test were performed to measure the combined effects of nuclear radiation and cryotemperatures on a group of nonmetallic spacecraft materials. This group consisted

of materials classified as adhesives, seals, thermal insulations, electrical insulations, structural laminates, potting compounds, sealants, and dielectrics. Typical tests performed on specimens prepared from the materials included tensile–shear strength, leakage, ultimate tensile strength, ultimate elongation, stress–strain characteristics, thermal conductivity, pullout strength of potted wire, and T-peel strength. Special test equipment allowed the specimens to remain submerged in liquid nitrogen during irradiation and subsequently to be tested without interruption of the cryogenic environment. Measured properties of the materials as a function of integrated neutron flux and gamma dose are reported. Author

N64-33045* IIT Research Inst., Chicago, Ill. Technology Center
INVESTIGATION OF SLIP-RING ASSEMBLIES Quarterly Report No. 5, 15 Apr.–5 Aug. 1964
O. M. Kuritza, W. H. Graft, R. E. Putscher, and D. E. Richardson [1964] 16 p
(Contract NAS8-5252)
(NASA-CR-58686; Rept.-E6000-15) OTS: $1.00 fs; $0.50 mf

Preliminary analyses of wear-debris deposits were conducted, and the basic noise characteristics demonstrated previously were verified with commercial slip-ring assemblies. Also, studies were initiated of precious-metal hardening agents for gold-plating baths, and of other basic noise parameters. The preliminary analysis of wear debris indicated that metallic constituents other than the expected gold are present. Laboratory evaluation indicated that commercial 80-circuit slip-ring assemblies exhibit the same vibration, threshold, and repeatability effects that were demonstrated by experimental capsules. A run-in test presently in progress indicates that 80° grooves may possess improved noise characteristics over the standard 90° grooves. P.V.E.

N64-33047* Grumman Aircraft Engineering Corp., Bethpage, N.Y.
RESEARCH ON MOLECULE-SURFACE INTERACTION. Part III. SURFACE CONTAMINATION Final Report, 1 Jul. 1963–9 Aug. 1964
Calvin H. Weiser Sep. 1964 22 p refs
(Contract NASw-709)
(NASA-CR-58960; RM-241) OTS: $1.00 fs; $0.50 mf

Experiments leading to the design of an apparatus for the preparation and photoelectric analysis of atomically clean metallic specimens are described. The system arrived at contains two electron guns, provisions for measuring very small currents (10^{-16} A), and means for introducing monochromatic ultraviolet light, electrical potentials, and ultrapure gases. Probable effects of surface contaminants on molecule-surface interactions and plans for incorporating surface preparation techniques into a shock-tube-driven molecular-beam apparatus are also discussed. Author

N64-33061* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
METALLURGICAL BONDING OF PLASMA SPRAYED TUNGSTEN ON HOT MOLYBDENUM SUBSTRATES
W. A. Spitzig and S. J. Grisaffe Repr. from Welding J. Res. Suppl., Sep. 1964 3 p refs Presented at the AWS Natl. Fall Meeting, San Francisco, 5–8 Oct. 1964
(NASA-RP-342)

Metallurgically bonded plasma-sprayed tungsten was applied on metallographically polished and preheated molybdenum substrates. The substrates were preheated to 1750° F or higher immediately before spraying. The preheating and spraying operation was performed in a nitrogen atmosphere. Metallurgical bonding occurred when the preheated substrate temperature ranged between 2200° and 3700° F. At these temperatures the molybdenum substrates completely recrystallized even though the total time for preheating, spraying, and cool down to 400° F was only about 30 sec. Cross sections of the coating and substrate indicate that the coating-to-substrate bond is the result of substrate grains growing into the coating. Author

N64-33101 Republic Aviation Corp., Farmingdale, N.Y. Manufacturing Research Dept.
ELECTRO-SPARK EXTRUDING Interim Technical Engineering Report No. 5, 1 Jul.–1 Oct. 1964
J. H. Wagner Wright-Patterson AFB, Ohio, Res. and Technol. Div., Oct. 1964 52 p
(Contract AF 33(657)-11265)
(RAC-2638; RTD-TR-8-111(V); RTD-IR-8-111(V); AD-449822)

The construction details of a pressure vessel for electrohydraulic extrusion consisting of a replaceable 250 maraging steel insert, a liner of the same material, and a modified E4340 steel container with threaded E4340 steel closure retainers to operate at hydrostatic pressures up to 200 000 psi are described. A steel extrusion die and an 18 kV electrode and spark gap are components in the high-pressure tooling. In addition, an adapter chamber containing a movable piston-ram with a maximum pressure capacity of 20 000 psi is furnished to operate with the pressure vessel. A pump-intensifier system with associated controls has been obtained to supply 200 000 psi water inhibited fluid to the pressure vessel. An electrical power supply rated at 15 kV dc two amperes output has been installed. Author

N64-33121* National Beryllia Corp., Haskell, N.J.
RESEARCH ON LOW DENSITY THERMAL INSULATION MATERIALS FOR USE ABOVE 3000°F Quarterly Status Report, 1 Apr.–30 Jun. 1964
K. H. Styhr [1964] 33 p
(Contract NASw-884)
(NASA-CR-59210) OTS: $2.00 fs; $0.50 mf

Refractory composites of ceramic oxides and refractory metals are being developed and evaluated for use as high-temperature thermal insulation. Several sources of high-purity (less than 1000-ppm impurities) zirconium dioxide powders are being evaluated with tungsten and molybdenum introduced in a variety of forms and concentrations. A high-temperature radial-heat-flow thermal-conductivity apparatus and a multiple gage section technique are described. Author

N64-33131 Army Material Command, Washington, D.C.
MILITARY PYROTECHNICS SERIES. PART TWO SAFETY, PROCEDURES AND GLOSSARY Engineering Design Handbook
Oct. 1963 65 p refs
(AMCP-706-186)

Safety precautions that apply to pyrotechnics may be summarized in these four rules: (1) Know the properties of ingredients and the reactions of compositions. (2) Recognize the dangerous situations that may arise because of potential or actual hazards. (3) Minimize the hazards by working with small samples and by observing established practices for safety equipment, processing, testing, storing, and disposal. (4) Observe the practices of good housekeeping. Safety in the pyrotechnics laboratory and plant is a major section of this part of the handbook. Other parts concern processing procedures and equipment, and particle-size procedures. D.E.W.

N64-33179* Wheeler Labs., Inc., Smithtown, N.Y.
DEVELOPMENT OF MACROSCOPIC OPTICAL WAVEGUIDE COMPONENTS Fourth Progress Report, May–Jun. 1964
E. Ronald Schineller 23 Jul. 1964 4 p. refs
(Contract NASw-888)
(NASA-CR-59176) OTS: $1.00 fs; $0.50 mf

An analysis of propagation in dielectric waveguides was made. It was found that propagation of a metal-bisected waveguide is identical for finite conductive as well as for perfectly conductive metal. A waveguide directional coupler, consisting of two parallel dielectric slab waveguides, has been analyzed, and the coupling region and waveguide separation was established. The minimum curvature radius for a typical waveguide separation was obtained. Tests of circular waveguides made of a quartz rod and tubing have been partially successful. G.G.

N64-33314 Crystalonics, Inc., Cambridge, Mass.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND TO INSURE THE RELIABILITY OF THE C600 SERIES FIELD EFFECT TRANSISTORS Quarterly Report, 1 Apr.–30 Jun. 1964
John R. Williams [1964] 33 p
(Contract DA-36-039-AMC-01483(E))
(QR-4; AD-606477)

Ultrasonic bonding was discarded in preference to a new metalization ball-bonding technique. All field effect transistors are being bonded die-to-header, using a heavy gold plate on dice and headers. As a result of packaging experiments, production units are being vacuum baked at 200° C and packaged in a dry nitrogen atmosphere of −60° C dew point or better. D.E.W.

N64-33323 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY FOR THE 2N656 Final Progress Report, Jul. 1, 1962–Mar. 31, 1964
Milton Le Baron, Elmer Wolff, Milton K. Mack, and James H. Overman [1964] 159 p
(Contract DA-36-039-SC-86730)
(Rept.-03-64-43; AD-602939)

The process improvement work on the 2N656 device was completed. The resultant transistor is a rugged planar device utilizing gold alloy wafer mounting and ultrasonic lead bonding with no inline etch or wafer coating and is capable of 15 W dissipation at 100° C case temperature. Improved facilities, processes, and process controls in the diffusion, photo resist, contact evaporation, and assembly areas have all contributed to the significantly improved product quality and uniformity. The major portion of reliability improvement has resulted from the planarization of the device and the redesign of the package that replaced the single 0.017-in.-diameter wire slug support with two approximately 0.015-in.-thick by 0.090-in.-wide tabs. Author

N64-33330* SKE Industries, Inc., King of Prussia, Pa. Research Lab.
BEARING LUBRICANT ENDURANCE CHARACTERISTICS AT HIGH SPEEDS AND HIGH TEMPERATURES Progress Report No. 8, 1 Jul.–30 Sep. 1964
C. J. Wachendorfer [1964] 53 p refs
(Contract NASw-492)
(NASA-CR-59283; AL-64T055) OTS: $3.00 fs; $0.50 mf

Four high-temperature lubricants—two hydrocarbons, an ester base oil, and a modified five-ring polyphenyl ether—were used to lubricate 20 consumable-electrode vacuum-melted (CVM) WB49 tool-steel 7205 angular-contact ball bearings at speeds up to 40 000 rpm, 365-lb-thrust load and mean temperatures up to 642° F. Several cage designs manufactured from two of the most wear-resistant materials, M-1 (Rc 55) steel and S-Monel (Rc 33), were utilized in bearings tested to aid in optimizing the cages that will be used in endurance tests. A materials screening program closely related to the high-speed high-temperature bearing program has continued in which potential cage materials are being evaluated for wear resistance when lubricated with candidate high-temperature oils in the modified flat-washer tester. Author

N64-33339 Philco Corp., Lansdale, Pa.
PEM FOR GOLD-DOPED GERMANIUM INFRARED DETECTOR TYPE IR400 Quarterly Progress Report, 27 Mar.–30 Jun. 1964
A. Guimento [1964] 38 p
(Contract DA-36-039-AMC-01464(E))
(QPR-6; AD-605859)

This report covers preproduction engineering measures for p-type gold-doped germanium infrared detectors of the type IR-400. Several preproduction samples were fabricated and partially tested. The mechanical alinement of the cell mount and the inner bore of the dewar have been accomplished with the use of a new sealing fixture. A complete set of mechanical drawings for this detector is included in this paper. G.G.

N64-33356 Carnegie Inst. of Tech., Pittsburgh, Pa.
UNCONVENTIONAL METHODS FOR INFLUENCING FLUID FLOW. VOLUME III. AN ION DRAG PUMP AND THRUST BEARING Final Report
Charles A. Timko (Ph.D. Thesis) Wright-Patterson AFB, Ohio, ASD, Nov. 1963 79 p refs
(Contract AF 33(657)-9914)
(ASD-TDR-63-776, Vol. III; AD-426989)

The ion-drag effect in which like-charge ions generated by corona are forced through a dielectric fluid by an electric field is investigated as a means of pressurizing fluids without the use of moving mechanical parts. A thrust bearing and a pump operating on this principle are studied both theoretically and experimentally. A mineral oil is used in the experiment as the working fluid. The effect is found to be quite small although flow rates greater than those obtained by previous investigators are observed. Experiments verified the analytic results of the pump and thrust bearing study. Other currents than the like-charge ionic current were found present. Also, the pressure effect decreased with time when mineral oil was used as the pumping medium. Author

N64-33368 Northrop Space Labs., Hawthorne, Calif.
HANDLING DANGEROUS MATERIALS IN CONFINED AREAS
Robert C. Musslewhite, Jr. Sep. 1964 23 p refs Presented at the 54th Air Force–Industry Conf., Palm Springs, Calif., 16–18 Sep. 1964
(NSL-64-244)

The handling of high-energy fuel–oxidizers and toxic materials in confined areas creates special problems. One such special problem was analyzed in a large space chamber containing a test article with significant quantities of hypergolic propellants (N_2O_4 and hydrazines), liquid hydrogen, and liquid oxygen on board. Published TNT equivalents and quantity distance numbers were not directly applicable, and special calculations were necessary. An example of a typical chamber is analyzed herein; results are reported. Author

N64-33433 Oklahoma U. Research Inst., Norman School of Aerospace and Mechanical Engineering
FATIGUE TESTING OF T-56 AIRCRAFT JET ENGINE PROPELLER SHAFTS Final Report, 1 Nov. 1963–1 Mar. 1964

Jay D. Montgomery May 1964 30 p
(Contract AF 34(601)-17360)
(AD-603142) OTS: $2.00

A series of T-56 aircraft jet-engine propeller shafts, 60A, were subjected to one million cycles of 180000 in. lb. bending moment and approximately 3000 cycles of 200000 in-lb torsional moment to determine if chrome plating would affect shaft fatigue. Four shafts were tested, two plated with 0.010-in. chrome and two unplated serviceable shafts. Test results indicated no visible damage to any of the shafts tested. Author

N64-33460 American Machine and Foundry Co., Alexandria, Va. Materials Dept.
DEVELOPMENT OF MANUFACTURING METHODS FOR DEPOSITION FORMING Interim Progress Report, 1 May–31 Jul. 1964
M. E. Browning, W. H. Webster, Jr., H. W. Leavenworth, Jr., and F. J. Dunkerley [1964] 43 p refs
(Contract AF 33(615)-1375)
(IPR-2; AD-444204)

Development work was continued for electroforming the cobalt–tungsten quaternary alloy and for depositing the dispersion-hardened nickel alloys by the electrocombination process. Studies made on operating variables of the cobalt–tungsten alloy bath included examining the effect of using high citrate concentrations in the bath, varying the content and ratios of W and Co, and evaluating the surface quality of deposits produced at various current densities. Work in the dispersion-strengthened nickel-alloy area included examining the effect of several deposition parameters (current densities, wetting agents, particle concentrations, etc.) on the resultant alloy. A new high-strength nickel bath was investigated, as well as two analytical techniques for determining particle concentrations in the deposited alloys. Author

N64-33505 Rocketdyne, Canoga Park, Calif.
INVESTIGATION, DESIGN, AND TEST OF EXPERIMENTAL LIQUID HYDROGEN PUMPS
Dec. 1963 35 p refs
(Contract AF 33(657)-11165)
(R-5343-2; AD-601016)

New work accomplished includes completion of three materials-compatibility tests, and accumulation of considerable operating time on a fourth test. Also completed were the pump design, approximately 40% of pump fabrication, and design of a self-contained pump test installation as a packaged unit. Fabrication of the pump test installation was started, along with the design of the test facility, including the liquid-hydrogen supply system, the purge-gas system, instrumentation, and controls. Among the materials-compatibility tests run, 262 hours of operation on one set of type 321 stainless-steel specimens (consisting of a tin-alloy-coated piston and an electrolyzed cylinder) were completed. Author

N64-33549 IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF 2400° F FORGING DIE SYSTEM Final Technical Documentary Report
T. Watmough and Paul R. Gouwens Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 147 p
(Contract AF 33(600)-42861)
(IITRI-B220-32; ML-TDR-64-228; AD-607310)

The upper operating temperature limit of Inconel 713C forging dies was determined by progressively increasing the load and temperature conditions of the die. Ultimate failure occurred by gross cracking at 1900° F under a 1000-ton load while forging steel. Using the die system operating at 1500° F, it was demonstrated that a steel aircraft part could be forged in a single step rather than the five die sequences normally required for the part. This was accomplished by introducing the concept of flash containment by a completely trapped die, thus combining the forging process with some features of extrusion. The part was produced directly from simple preform shapes of bars or round-cornered squares of the proper volume. Positioning of the billet within the die cavity influenced the ability to fill the cavity. For the 2400° F die development effort, a number of ceramic, intermetallic, metal-ceramic composites, and refractory metals were screened for strength, oxidation resistance, and punch deformation behavior. Author

N64-33555 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION DEVELOPMENT OF A SILICON PLANAR EPITAXIAL TRANSISTOR WITH A MAXIMUM OPERATING FAILURE RATE OF 0.001% PER 1000 HOURS AT A CONFIDENCE LEVEL OF 90% AT 25°C Final Engineering Report, 1 May 1962–30 Oct. 1963
[1963] 154 p
(Contract DA-36-039-SC-86728)
(AD-607294)

This report contains a summary of the results of the efforts expended in the reliability engineering area. Also contained are summaries of process change evaluation experiments, acceleration factor experiments, and large-scale testing. Comparisons are made of parameter distribution and stability, failure rate, and mechanical ruggedness between the several processes developed during this program. Author

N64-33583 Hanford Atomic Products Operation, Richland, Wash.
N-REACTOR PROCESS TUBE ROLLED JOINT
J. H. Fastabend Aug. 1964 41 p refs
(Contract AT(45-1)-1350)
(HW-83386) OTS: $2.00

The rolled joint met or surpassed all design and operating criteria under which it was evaluated. Bending loads concurrent with thermal cycling, thermal transient tests, and burst tests were applied without separation of the joint. No leakage was detected on any of the properly formed joints tested under design conditions of 1800 psi and 600° F. Tensile strength of the joint was determined to be 50% greater than design requirements. Relaxation tendencies of the joint were evaluated over a 6-month thermal cycling period, which showed a reduction in residual interface stress of approximately 1000 psi. Studies of the effect of process water and decontamination solutions on the joint resulted in no corrosion problem. The front rolled joint did not inhibit fuel element passage. Author

N64-33608* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRECISION TOOLING TECHNIQUES Technology Utilization Notes
Washington, NASA, Oct. 1964 29 p
(NASA-SP-5013) GPO: $0.25

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N64-33609* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PRECISE LATERAL-ADJUSTMENT INSTRUMENT SUPPORT

Wilhelm Angele and Donelson B. Horton *In its* Precision Tooling Tech. Oct. 1964 p 1–2 (See N64-33608 24-17) GPO: $0.25

A versatile and reliable support instrument for use in precisely centering instruments such as Indi-Ron and Talyrond to determine or measure the roundness of an object is described. The support can be attached to any measuring or gaging apparatus for checking roundness, and allows lateral adjustment to within 1-millionth of an inch. The adjustable instrument support can be made of any metal that has a high modulus of elasticity. P.V.E.

N64-33610* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

HARD-ANODIZED ALUMINUM LAPS

William J. Abernathy *In its* Precision Tooling Tech. Oct. 1964 p 3–4 (See N64-33608 24-17) GPO: $0.25

The advantages of using hard-anodized aluminum in machining and lapping precision parts are discussed. It was found that hard-anodized aluminum laps, with a surface hardness equal to that of a sapphire, lasted longer before reworking and produced better surface finishes than laps made of such materials as cast iron (meehanite), brass, or granite. P.V.E.

N64-33611* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MACHINE FOR LAPPING SPOT FACES

William J. Abernathy, William J. Reed, John R. Sealy, and Lowell G. Snoddy *In its* Precision Tooling Tech. Oct. 1964 p 5–8 (See N64-33608 24-17) GPO: $0.25

The lapping machine was built to generate precision circular spot faces, 0.218 inch in diameter by 0.0002 to 0.0004 inch in depth, coaxial with the air nozzles (holes 0.018 inch in diameter) in air-bearing end plate. The components of the machine are a base plate mounted on a lathe carriage, a small-drive motor, a bearing block, an adjustable bearing housing, and a spindle with a lapping wheel. The lapping machine was also used to generate annular grooves, 0.125 inch wide and 0.002 inch deep. P.V.E.

N64-33614* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

CHAMFERING SMALL HOLES

William J. Abernathy *In its* Precision Tooling Tech. Oct. 1964 p 15–17 (See N64-33608 24-17) GPO: $0.25

The use of soft solder and piano wire charged with diamond to chamfer small holes is described. Solder-ball laps are made of solder a few thousandths of an inch smaller in diameter than the hole to be chamfered. A small amount of laping compound is placed on the solder ball before use. The end of the length of solder opposite the ball is then inserted into the hole to be chamfered, and the solder drawn through until the ball contacts the surface of the work. The solder, held between thumb and forefinger, is spun back and forth in the hole. Piano wire charged with diamond compound is effective for deburring blind holes or holes drilled at angles other than 90° to the surface. The wire is charged by rolling it between two hardened and ground pieces of steel, such as lathe tool bits. The charged wire is held in a pin vise for the chamfering operation. P.V.E.

N64-33615* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

UNIVERSAL LATHE AND JIG BORE FIXTURE HOLDER

John R. Sealy *In its* Precision Tooling Tech. Oct. 1964 p 19–22 (See N64-33608 24-17) GPO: $0.25

The fixture holder is made of hard-anodized aluminum to resist wear. It has two lapped faces that are parallel to within 5-millionths of an inch. Each face has a 1-inch hole through the center, perpendicular to the parallel-lapped faces. The holes are equally sized and lapped to within 20-millionths of an inch. A variety of brass inserts may be used interchangeably with fixtures mounted on a lathe and a jig bore, depending on the operation required. A lathe, to be used with the fixture, is first prepared by mounting a stress-relieved backup plate to the faceplate. The backup plate is cut as true and perpendicular to the axis of the lathe as the runout of the lathe spindle bearing will permit. The fixture allows transfer of a part from one machine to another with a minimum of setup time. P.V.E.

N64-33616* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PRECISION LATHE MOUNTING RING

John R. Sealy and Lowell G. Snoddy *In its* Precision Tooling Tech. Oct. 1964 p 23–25 (See N64-33608 24-17) GPO: $0.25

A lathe mounting ring is described that was devised to meet the requirements of the following problem job—the precision machining of parts requiring multiple parallel surfaces and concentric bores. In the problem, the surfaces of each part were to be faced-off parallel to lapped reference pads, and bores made concentric to the axis of the part to within 50-millionths to 60-millionths of an inch. P.V.E.

N64-33682* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PREFERRED PARTS, MECHANICAL. VOLUME II

1 Jul. 1964 132 p

(NASA-TM-X-54789) OTS: $4.00 fs; $0.75 mf

This is a selection guide for preferred, reliable mechanical parts to be used in space vehicles. Temperature and strength ranges were established by either the materials manufacturer or by previous operational experience. All dimensions are given in inches. G.G.

N64-33719 Springfield Armory, Mass. Research and Engineering Div.

ELECTROMAGNETIC METHOD OF NONDESTRUCTIVELY EXAMINING COMPONENTS FOR EXCESSIVE DECARBURIZATION

H. P. Hatch and K. A. Fowler 14 Apr. 1964 20 p ref

(SA-TR-19-1508; AD-444348)

An electromagnetic test is described that was developed to nondestructively detect severely decarburized components. The test method is based on measurements of the third harmonic component of an induced secondary voltage. This test parameter was found to correlate well with surface hardness, which is a measure of the severity of decarburization. On the basis of the results of this investigation, it can be concluded that harmonic analysis of an induced voltage is applicable to

the nondestructive evaluation of the surface condition of steel. Procedure is described, and results are discussed. Author

N64-33745 Southwest Research Inst., San Antonio, Tex.
A STUDY OF EXISTING BASE FUEL HANDLING PROCEDURES IN RELATION TO MICROBIAL CONTAMINATION Technical Documentary Report, 24 Sep. 1962–8 Apr. 1964
Robert K. Johnston, F. W. Bieberdorf, R. G. Weichlein, J. C. Tyler, and R. D. Brown Wright-Patterson AFB, Ohio, Systems Eng. Group, Jun. 1964 238 p refs
(Contract AF 33(657)-9762)
(SEG-TDR-64-29; AD-603852)

A survey of the JP-4 fuel-handling facilities and procedures at three Air Force bases has indicated no serious contamination, microbial or otherwise. The water bottoms throughout the fuel systems were either sterile or contained very few microorganisms, with appreciable counts observed only on a single sample from each base. The general housekeeping and observance of prescribed fuel-handling procedures appeared adequate. Experimental studies were made of microbial growth in 4000-gallon tanks and in 15-gallon drums, in which JP-4 fuel was stored over dilute sea water with varying proportions of glycerin and methoxyethanol, inoculated with selected microorganisms. Effective inhibition of growth was observed in water bottoms containing 20% methoxyethanol, and some inhibition with 10% methoxyethanol; lower concentrations allowed vigorous growth. It was found that the addition of 20% methoxyethanol effectively sterilized the contents of a tank in which growth was already established. Author

N64-33754 Mare Island Naval Shipyard, Vallejo, Calif. Rubber Lab.
DEVELOPMENT OF ACOUSTIC FILTER CONTAINING RUBBER SPRING ELEMENTS Final Report
J. J. Eynck 26 Aug. 1964 46 p refs
(Rept.-165-34; AD-445728)

The filter design investigated utilized the closed end of the rubber spring elements as seals for the hydrostatic pressure and consisted of a concentric arrangement of six cartridge filter elements parallel with the pipeline and needed no external bracing. Filter elements were characterized for pressure-deflection relationship, as well as for resonant frequency as a function of load. The tunable frequency range was 165 cps to about 800 cps. In a pressure-cycling endurance test to failure, six filter elements exceeded 10 000 cycles from 0 to 1000 psig. Hydrostatic pressures exceeding 3200 psig were required to rupture six filter elements. Author

N64-33789* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SELECTED WELDING TECHNIQUES, PART II Technology Utilization Notes
Washington, NASA, Jul. 1964 39 p
(NASA-SP-5009)

This paper discusses various tools and techniques employed in the welding of aluminum sheets and plates. It contains the following topics: "Conventional Weld Joints Versus Butt Joints in 1-inch Aluminum Plate"; "Special Weld Joint Preparation"—continuous welding of large aluminum tank segments by the gas tungsten-arc process; "Upset Metal Edges for Increased Weld Joint Strength"—a new process that allows material thickness selection based on stress requirements only; "Out-of-Position Welding of Heavy Gage Aluminum Alloy in Space Vehicle Applications"; "Electron Beam Welding"—a new fusion welding process; "Gas Metal-Arc Welding Versus Electron Beam Welding"—a new procedure for utilization of the superior electron-beam welding for the Y-ring segments; "Development of Improved Weld Filler Wire"; "Special Welding Nozzle Configuration"; "Fiber Optics"; "Non-Free-Wheeling Thyratron-Type Motor Governor"; "Magnetic Field Effects on a Direct-Current Welding Arc"—the adverse effects on welds are shown in a test series; and "Economy Automation for Welding of Space Vehicles." G.G.

N64-33792 Army Tank-Automotive Command, Center Line, Mich. Components Research and Development Labs.
X-RAY ANALYSIS OF TITANIUM COATINGS AND FILMS
Gregory Arutunian 16 Mar. 1964 36 p refs
(Rept.-8251; AD-444349)

Geiger counter and X-ray film techniques were used to study the crystalline structures of thin titanium films and coatings formed by vacuum deposition. An X-ray analysis of the various titanium films was used to determine the effects of temperature and of base-metal orientation upon the structures of the deposited films. Results indicate that the degree of preferred orientation of the films can be altered by variations in the vacuum deposition technique. Attempts were made to correlate film orientation with adhesion and corrosion resistance properties. Author

N64-33812* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EXPERIMENTAL INVESTIGATION OF ULTRA-HIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE First Quarterly Progress Report, 1 Jul.–30 Sep. 1964
J. A. Ryan 26 Jun. 1964 30 p refs
(Contract NAS7-307)
(NASA-CR-59364) OTS: $2.00 fs; $0.50 mf

The vacuum system was assembled, the experimental apparatus was constructed, and the initial silicate samples were prepared. The main unresolved problem was the inability to obtain the desired vacuum due to flange warping. Systems are described for producing and maintaining a vacuum, for applying loads, for measuring the adhesion, and for heating various parts of the vacuum system. Sample choice criteria and preparation techniques are described. D.E.W.

N64-33844 Mound Lab., Miamisburg, Ohio
ELECTRON BEAM WELDING OF ANNEALED TANTALUM SHEET
J. R. Mc Dougal and R. E. Vallee 1 Apr. 1964 11 p
(Contract AT(33-1)-GEN-53)
(MLM-1193) OTS: $0.50

Electron-beam-welding techniques were developed for joining 0.080-in., high-purity annealed tantalum sheet. Maximum joint strength with minimum heat input was desired. In preliminary studies it was determined (1) that weld penetration of the tantalum could be controlled within ±0.003 in.; and (2) that tensile and yield strength were slightly higher for the weld metal than for the parent material, although the elongation decreased from 40.5% to 23.5% due to recrystallization of the metal. Weld specimens were prepared with 0.020- × 0.020-in. step joints (which were easier to machine than the initially tested 0.010- × 0.010-in. step joints). The joint efficiency was 92% with only 75% penetration. Additionally, the low power requirements (1320 joules/in.) gave a maximum temperature of 300° C at the metal surface opposite the weld. Author

N64-33850 Joint Publications Research Service, Washington, D.C.
VACUUM DIFFUSION WELDING OF METALS AND ELECTROSLAG WELDING OF ALLOY STEELS

A. V. Krivoshey et al 28 Oct. 1964 24 p refs Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 7, Jul 1964 p 13–19
(JPRS-27115; TT-64-51371) OTS: $1.00

This study discusses diffusion welding in a vacuum of two refractory metals, or the joining of refractory metals with alloys by the same method. In the electroslag welding of high-alloyed steels of the austenitic–ferrite or ferrite–martensite class with low-alloyed steel, the welding wire increases the chromium and nickel content enough to guarantee austenitic structures, but the metal of the seam possesses insufficient strength. By the addition of Armco iron of 8- to-12-mm thickness into the seam, an optimal combination of strength and plastic properties for the welded joints of high-alloyed steels with low-alloyed steels was obtained. G.G.

N64-33905* Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.
EVALUATION OF CLEANING PROCESSES UTILIZING RADIOISOTOPES
Richard A. Gaz, Alvin B. Kaufman, and Paul H. Dutch [1964] 16 p Presented at the 1964 SAE Natl. Aeron. and Space Mfg. Forum, Los Angeles, 5–9 Oct. 1964 Sponsored by NASA
(NASA-CR-59376) OTS: $1.00 fs; $0.50 mf

A minute quantity of radioisotope was deposited on the surface of the test specimens; the parts were measured for radioactivity before and after the cleaning process using a Geiger–Muller detector. The ultrasonic cleaning processes evaluated consisted of a cascade series of numerous cleaning solutions or baths, such as Tergitol, Trend, or Turco No. 3878 preceded by a Chlorothene Nu degreaser step. It was found that the Turco bath was the most effective cleaning solution in comparison to the Tergitol, Trend, and Chlorothene Nu. The optimum cleaning time was 2 min for the Turco, 3 min for the Tergitol bath, 4 min for the Trend bath, and 15 min for the Chlorothene Nu. Author

N64-33922* Martin Co., Denver, Colo.
EXPLOSIVE FORMING AND WELDING OF HONEYCOMB SANDWICH MATERIAL
A. Ezra, N. Ida, R. Agricola, and N. Burningham Oct. 1964 114 p
(Contract NAS8-5463)
(NASA-CR-59395; NASA-CR-64-36) OTS: $4.00 fs; $0.75 mf

A joint design was selected, honeycomb sandwich panels were prepared, and joints were welded and tested. A short probe radiographic technique was developed for the nondestructive testing of welded joints. An optimum procedure for the explosive forming of composite end-cap segments of honeycomb sandwich panel, using a patented wax-forming process, was established. D.E.W.

N64-33928 Republic Aviation Corp., Farmingdale, N.Y.
RESEARCH INVESTIGATION OF HYDRAULIC PULSATION CONCEPTS Final Report, 15 Feb. 1963–15 Aug. 1964
F. H. Pollard Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 207 p refs
(Contract AF 33(657)-10622)
(APL-TDR-64-109; AD-607618)

The technical feasibility of the transmission and utilization of hydraulic power through the use of pulsating pressure or pulsating flow concepts was investigated. It was concluded that the pulsating flow means were suitable for power transmission, whereas pulsating might be adapted for signal transmission. The type of system currently in greatest use in aerospace vehicles is the constant pressure flow demand system that utilizes a pressure-compensated variable delivery pump. An adaptation of this system to the requirements of a pulsating system will produce the most desirable means of control from the standpoints of efficiency, simplicity, and reliability. The research investigation was carried on by two methods—the design effort and the analytical method. The laboratory effort was limited to relatively simple experiments intended to verify or facilitate analytic results. The system analysis was augmented and verified by data derived from a miniaturized pulsating hydraulic system. Author

N64-33950 Thiokol Chemical Corp., Huntsville, Ala. Huntsville Div.
NOZZLE AND CASE EVALUATION Quarterly Interim Technical Report, 22 Mar.–21 Jun. 1964
26 Aug. 1964 19 p refs
(Contract DA-01-021-ORD-11919)
(Rept.-30-64; AD-445888)

This report describes the hydrotesting of a 20-in.-diam, spiral-wrapped, maraged strip steel motor case. The report also describes the preparations being conducted for hydrotesting two 12-in.-diam, cryogenically formed motor cases and a second-stage Pershing motor case manufactured by the hot-cup, cold-draw process. Also reported are the preparations for static testing a 2-in.-diam titanium boronitride nozzle-throat insert. Author

N64-33963 Rocketdyne, Canoga Park, Calif.
INVESTIGATION, DESIGN, AND TEST OF EXPERIMENTAL LIQUID HYDROGEN PUMPS Technical Documentary Report, 15 Jun. 1963–1 Jun. 1964
Lyle Fuller Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jun. 1964 120 p refs
(Contract AF 33(657)-11165)
(R-5730; APL-TDR-64-86; AD-603548)

Within the defined operating limits, analyses of all known applicable types of pumps were made. On the basis of these analyses, a piston-type pump with essentially zero clearance volume was selected. A general design configuration was worked out and theoretical performance analysis was completed. In addition, materials compatibility tests to determine suitable materials for the mating surfaces of an extremely close clearance piston and cylinder combination that could operate with only hydrogen as a lubricant and/or coolant were started. The objective of obtaining 300 hours of accumulated running time on one set of piston and cylinder specimens in the materials compatibility tests was achieved. Final design, fabrication, and testing of an experimental pump was also achieved. Further analysis of critical piston-to-cylinder clearances was performed, and a pump test installation was designed and built. Author

N64-33987* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECTS OF VACUUM AND NUCLEAR RADIATION ON ENGINEERING MATERIALS
William R. Lucas Repr. from Symp. on Space Radiation Effects, Spec. Tech. Publ. no. 363, 1964 p 106–120 refs
(NASA-RP-349)

This paper deals with the state of knowledge of the resistance of engineering materials to vacuum, radiation, and to radiation plus vacuum. Emphasis is on vehicle and reactor accessory hardware rather than on reactor materials. Selected data obtained from an investigation of the combined effects of reactor radiation and vacuum on organic engineering materials are discussed. The data include results of mechanical tests before and after irradiation. The test specimens are representative specimens of thermal insulation, potting compounds, structural laminates, structural adhesives, thermal control coatings, dielectric materials, seals, and lubricants. Author

N64-34002 Springfield Armory, Mass. Research and Engineering Div.
EXPERIMENTAL ELECTROMAGNETIC TEST METHODS FOR THE NONDESTRUCTIVE EVALUATION OF CARBURIZED STEEL PARTS
H. P. Hatch and K. A. Fowler 29 Apr. 1964 54 p refs
(SA-TR-19-1509: AD-603536)

Several experimental electromagnetic test methods were investigated for application to the nondestructive evaluation of carburized steel parts. The results show that an accurate and rapid measure of the case depth of carburized parts can be made, based on measurements of the phase of the third harmonic component of the secondary test-coil voltage. This test parameter can be relatively insensitive to certain normal process variables. An ac inductance bridge was used to obtain measurements indicative of the tempering temperature and free ferrite content of the part. The results of an investigation concerning the influence of retained austenite and residual stress on the magnetic comparator evaluation of carburized steel samples are also reported. Experimental procedures are outlined, and results are discussed in terms of potential applications to nondestructive testing problems. Author

N64-34010* Battelle Memorial Inst., Columbus, Ohio
GAS-PRESSURE BONDING OF STAINLESS STEEL-REINFORCED BERYLLIUM HYPERVELOCITY IMPACT TARGETS Summary Report
R. J. Diersing, D. D. Carmichael, H. D. Hanes, and E. S. Hodge
15 Jul. 1964 18 p refs
(Contract NAS3-5139)
(NASA-CR-54222) OTS: $1.00 fs; $0.50 mf

The gas-pressure-bonding process was successfully developed as a fabrication technique for making stainless-steel-reinforced beryllium hypervelocity-impact targets. Three designs for reinforcing the beryllium structures were fabricated—kinked-wire filament reinforcement, wire-mesh reinforcement, and compartmented reinforcement. Twelve tubular-shaped reinforced beryllium targets were prepared from beryllium powder and the appropriate stainless steel reinforcement. Gas-pressure-bonding conditions of 1500° F for 2 hr at 10 000 psi were utilized to densify the beryllium powder to approximately theoretical density and simultaneously bond the beryllium to the stainless steel reinforcement. All three methods studied to reinforce the beryllium were successfully fabricated and were demonstrated to be feasible. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see:* 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-32699 IIT Research Inst., Chicago, Ill.
COPPER-COOLED TUNGSTEN FIBER ROCKET NOZZLE MATERIALS
N. M. Parikh *In* Army Mater. Res. Agency Proc. of the Rocket Nozzle Mater. Symp. Dec. 1963 p 129–142 (See N64-32692 24-17)
(Contract DA-11-022-505-ORD-3092)

Copper-alloy and silver-alloy cooled tungsten-fiber rocket-nozzle materials have been investigated. Short (0.25 in. length) unsintered tungsten fibers having diameters ranging from 0.001 in. to 0.006 in. were compressed into nozzle shapes and infiltrated with a number of copper and silver alloys. Constant diameter fibers were used in each compact. The fabrication techniques are described. The infiltrated specimens were evaluated for room-temperature tensile strength, micro-hardness, and compression ductility. The transverse rupture strengths of tungsten-fiber silver composites were measured at 2300° F and compared with commercial composites made from sintered tungsten powder. Author

N64-32772* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
LIQUID-METAL TECHNOLOGY
Louis Rosenblum *In its* Conf. on New Technol. 1964 p 97–103 (See N64-32767 24-01) GPO: $1.00

The unique physical properties of liquid metals that make them particularly advantageous in high-temperature heat transfer, and working fluid and electrical applications are discussed. These include a large liquid-temperature range, stability to heat and nuclear radiation, large volumetric heat capacity and high thermal conductivity, and special electrical properties. Some industrial uses of these metals are proposed. M.P.G.

N64-32804 General Electronic Co., Cincinnati, Ohio Advanced Technology Services
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 40, Part A
15 Oct. 1964 29 p refs
(Contract AT(40-1)-2847)
(GEMP-40A) OTS: $2.00

Results are given of modulus-of-rupture measurements at elevated temperatures of irradiated BeO, and of elastic constant and modulus-of-rupture measurements of unirradiated BeO. A low-pressure ion source and target assembly was tested for use in determining the diffusion characteristics of Kr, Xe, and I atoms in ceramic oxides subsequent to their injection via ion bombardment. Krypton-85 concentration profiles indicated that Kr-85 diffused into a sample of tantalum heated to 1850° C under glow discharge conditions. Permeation studies of arc-test tantalum indicated a permeation rate less than 6.5×10^{-12} ml of gas at STP per cm^2 of surface area per mm of wall thickness per cm of Hg pressure per second, at temperatures of about 2400° C. X-ray diffraction analysis of the area of interest in the UO_2-ThO_2-Y_2O_3 system showed a complete series of face-centered-cubic solid solutions. Results are reported on the effect of sintering temperature on fuel retention in BeO-base fuel elements. R.L.K.

N64-32819 General Dynamics/Astronautics, San Diego, Calif.
PHYSICAL AND MECHANICAL PROPERTIES OF PRESSURE VESSEL MATERIAL FOR APPLICATION IN A CRYOGENIC ENVIRONMENT Yearly Summary Report, 15 May 1963–15 May 1964
J. L. Christian, C. T. Yang, and W. E. Witzell [1964] 127 p refs
(Contract AF 33(657)-11289)
(GD/A-63-0818-3; AD-413851)

A discussion of the test program, selection of test materials, and brief descriptions of the test specimens and testing apparatus are given. The test results obtained to date are presented and discussed. The test data include tensile, notched tensile, weld tensile, axial fatigue, and crack propagation properties of 7039-T6 aluminum alloy, 18% nickel maraging steel, Hastelloy B, and 718 nickel-base alloy from 75° to −423° F. Author

N64-32820 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
MECHANICAL AND PHYSICAL PROPERTIES OF SUPER ALLOY AND COATED REFRACTORY ALLOY FOILS Second Quarterly Progress Report, 15 Aug.–15 Nov. 1963
J. L. Cook, D. E. Schuak, and C. T. Powers Nov. 1963 35 p refs
(Contract AF 33(657)-11207)
(SM-44631; AD-442734)

Preliminary tests indicate the need for further development of the tensile specimen configuration for the super alloys. Designs have been explored that cause fracture in the gage length. A study of the effect of the design on actual mechanical property values has been initiated. A satisfactory design for the tensile testing of refractory alloys has been developed.
Author

N64-32829* Battelle Memorial Inst., Columbus, Ohio
THE PHENOMENON OF HOT-SALT STRESS-CORROSION CRACKING OF TITANIUM ALLOYS
W. K. Boyd and F. W. Fink Washington, NASA, Oct. 1964 46 p refs
(Contract NASr-100(04))
(NASA-CR-117) OTS: $1.25

This is a discussion of stress-corrosion cracking of titanium alloys for supersonic aircraft by hot salt and of its mechanics of attack. Titanium-alloy samples underwent creep testing, cyclic exposure, and multiple applications of various salt compositions. It was found that below 500° F the hot-salt problem was not particularly serious, but the skin stresses above 500° F produced a hot-salt problem of concern. It appeared that air movement decreases susceptibility to hot-salt cracking and that titanium is not corroded in the vicinity of salt, but only upon direct contact with it.
G.G.

N64-32842 Joint Publications Research Service, Washington, D.C.
PHYSICS OF SEMICONDUCTORS AND METALS
7 Oct. 1964 100 p refs Transl. into ENGLISH of the book "Fizika Poluprovodninov i Metallov" Moscow, Acad. of Sci. USSR, 1964 p 1–76
(JPRS-26774; TT-64-51031) OTS: $3.00

CONTENTS:

1. THE ELECTROCHEMICAL OXIDATION OF BARRIER-LAYER METALS I. S. Zhukova and L. L. Odynets p 4–20 refs (See N64-32843 24-07)

2. ELECTRICAL PROPERTIES OF OXIDE FILMS ON BARRIER-LAYER METALS AND THE MECHANISM OF ELECTROLYTIC RECTIFICATION I. S. Zhukova and L. L. Odynets p 21–50 refs (See N64-32844 24-25)

3. X-RAY INVESTIGATION OF THE MECHANISM OF FATIGUE OF ANNEALED STEELS M. M. Konyuk p 51–64 refs (See N64-32845 24-18)

4. INVESTIGATION OF THE MECHANISM OF FATIGUE OF COLD-WORKED STEEL ALLOYS M. M. Konuuk and Yu. S. Terminasov p 65–70 refs (See N64-32846 24-18)

5. THE METHOD OF FOURIER-ANALYSIS OF INTERFERENCE LINES FOR SEPARATION OF EFFECTS OF BROADENING AS A RESULT OF MICRO-DISTORTIONS OF THE LATTICE AND OF THE DISPERSIVENESS OF THE BLOCKS O. N. Shivrin p 71–80 refs (See N64-32847 24-25)

6. X-RAY ANALYSIS OF STRUCTURAL CHANGES DURING AGING OF Cu–Cr AND Cr–Sn ALLOYS P. P. Vasil'yev and O. N. Shivrin p 81–91 refs (See N64-32848 24-18)

7. THE APPLICATION OF PRELIMINARY ELECTRO-SPARK TRANSFER IN SPECTRAL ANALYSIS M. N. Palladin, V. S. Baskov, and A. I. Koroleva p 92–98 refs (See N64-32849 24-25)

N64-32845 Joint Publications Research Service, Washington, D.C.
X-RAY INVESTIGATION OF THE MECHANISM OF FATIGUE OF ANNEALED STEELS
M. M. Konyuk *In its* Phys. of Semiconductors and Metals 7 Oct. 1964 p 51–64 refs (See N64-32842 24-18) OTS: $3.00

Steel alloy 40X was used for the investigation. Crystalline blocks of the order of 10^{-3} and 10^{-5} cm were obtained at an annealing temperature of 800° C in vacuum for 2.5 hours, and at 650° C for 2 hours, with subsequent cooling while in the furnace. The fatigue test was produced on the "N_u" machine and conducted at loads above and below fatigue limits. The X-ray photography was performed on the URS-501. Fragmentation of the crystal blocks occurred during stresses above, at, and below the limits.
A.W.

N64-32846 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE MECHANISM OF FATIGUE OF COLD-WORKED STEEL ALLOYS
M. M. Konyuk and Yu. S. Terminasov *In its* Phys. of Semiconductors and Metals 7 Oct. 1964 p 65–70 refs (See N64-32842 24-18) OTS: $3.00

Investigation of 40X-steel that was preliminarily cold-worked by grinding on samples of crystalline blocks of the order of 10^{-3} and 10^{-5} cm showed the following: (1) A surface layer cold-worked in this manner becomes greatly distorted. (2) Removal of microdistortions occurs for loads above, at, and below the fatigue limit, and is produced by heat arising in deformation. (3) The decrease of X-ray interferences occurs only at loads above and equal to the fatigue limit. (4) The common mechanisms of the fatigue process of annealed and preliminarily cold-worked metals and alloys are those distortions of crystal structures producing a decrease in intensity of X-ray interferences only at loads above and equal to the fatigue limit.
A.W.

N64-32848 Joint Publications Research Service, Washington, D.C.
X-RAY ANALYSIS OF STRUCTURAL CHANGES DURING AGING OF Cu–Cr AND Cu–Cr–Sn ALLOYS
P. P. Vasil'yev and O. N. Shivrin *In its* Phys. of Semiconductors and Metals 7 Oct. 1964 p 81–91 refs (See N64-32842 24-18) OTS: $3.00

Samples of the alloys were hardened in water after being kept in the furnace at a temperature of 1000° to 1020° C for 30 minutes. Besides investigation of monolithic samples, the alloys were studied in the form of powder obtained by sawing from hardened rods. The X-ray investigation was reduced to the measurement of the width of lines. For powder samples, a measurement was made of the integral intensities of seven first reflections of the Debye spectrum. It was established that there are differences in the dependence of the microhardness on the annealing time for different aging conditions. The intensity in the aging process of all the lines changes little.
A.W.

N64-32889* Columbia U., New York, N.Y.
[FIELD ION MICROSCOPIC STUDIES OF TUNGSTEN AND PLATINUM] Annual Report, 1 Jul. 1963–30 Jun. 1964

E. S. Machlin 30 Jul. 1964 9 p ref
(Grant NsG-294-63)
(NASA-CR-58771) OTS: $1.00 fs; $0.50 mf

The following qualitative observations by field ion micrography have been made. In tungsten and tungsten alloys undergoing a variety of heat treatments, the formation of stacking faults was stabilized by the presence of carbon. In point defects of irradiated platinum-wire, clusters of interstitials as distinguished from atoms, were found. G.G.

N64-32894* Franklin Inst., Philadelphia, Pa.
FATIGUE STUDIES OF SINGLE CRYSTAL BERYLLIUM
J. F. Breedis, A. Lawley, and J. A. Zeiger [1964] 27 p refs
(Contract NASr-145)
(NASA-CR-59031) OTS: $2.00 fs; $0.50 mf

Transmission electron microscope studies have been made of the dislocation arrangements in zone-refined Pechiney beryllium oriented for basal or prism slip following fatigue at room temperature. Fatigue modes include reverse bending at 1800 cpm and low-frequency (~ 2 cpm) uniaxial tension or compression cycling. The surface slip structure in bend fatigue was examined optically and also by using high-resolution silicon monoxide replicas. Author

N64-32952 Southwest Research Inst., San Antonio, Tex.
DYNAMIC DEFORMATION OF SINGLE AND POLYCRYSTALLINE ALUMINUM
Ulric S. Lindholm and Lester M. Yeakley 26 Aug. 1964 31 p refs
(Contract DA-23-072-ORD-1674)
(TR-2; AD-446646)

Single-crystal and polycrystalline specimens of high-purity aluminum were tested in compression at strain rates to 500 sec $^{-1}$ using the split Hopkinson pressure bar method. Using the theory of the thermally activated deformation of metals, activation volumes for the single crystals were calculated and found to be dependent upon both the orientation of the crystal with respect to the loading axis and the average strain. For the same strain, activation volume for the polycrystalline material is near the average of the variously oriented single crystals, indicating that the same rate-controlling mechanism is operative. The addition of impurities in aluminum leads to a reduction in rate sensitivity as evidenced by an increase in activation volume. The application of thermal activation theory to high-strain-rate testing is discussed. Author

N64-32983 University Coll. of Cardiff (Gt. Brit.)
IRON-CHROMIUM-NITROGEN ALLOYS Annual Technical Report No. 4
R. Rawlings and G. L. Richards 31 May 1964 29 p refs
(Contract DA-91-591-EUC-2863)
(AD-445860)

The solubility of CrN in ferrite containing 10% Cr was determined by measuring the internal friction of specimens vibrating in torsion at about 0.8 cps. Measurement of the height of the Snoek peaks indicates that the solubility product [Cr] [N] increases with chromium content at 700° and 800° C. The formation of nitride at 700° and 800° C in an Fe-13% Cr alloy was investigated using various metallographic techniques. The nitride was observed by optical metallography, and by replica and electron microscopy. In specimens nitrided at 700° C, coarse nitride precipitates were observed both at and within the ferrite grains. The precipitate occurred mainly as angular particles but also occurred occasionally as rods. The problem of the nucleation of the nitride is discussed, and it is indicated that dislocations are the most probable nucleating sites within the grains. The nitride at 700° C was again identified as CrN, both by X-rays and electron diffraction. P.V.E.

N64-33011 National Lead Co. of Ohio, Cincinnati Technical Div.
[INSPECTION OF URANIUM AND URANIUM METALS BY ELECTRON MICROSCOPY] Summary Technical Report, 1 Jul.–30 Sep. 1964
R. Burgett, ed. 20 Oct. 1964 23 p refs
(Contract AT(30-1)-1156)
(NLCO-930)

CONTENTS:

1. PREPARATION OF THIN-FOIL SPECIMENS FOR TRANSMISSION ELECTRON MICROSCOPY M. M. Cook 3 p ref
2. EXAMINATION OF AS-CAST URANIUM-CARBON ALLOYS BY ELECTRON MICROSCOPY W. A. Althaus, M. M. Cook, and R. J. Bieker 10 p refs
3. COLOR TECHNIQUE FOR THE IDENTIFICATION OF INCLUSIONS IN URANIUM METAL E. L. Schaich 5 p refs

N64-33060 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
STAINLESS STEEL INFORMATION MANUAL FOR THE SAVANNAH RIVER PLANT. VOLUME I: PROPERTIES
W. C. Rion, Jr, comp. Jul. 1964 213 p
(Contract AT(07-2)-1)
(DP-860, Vol. 1) OTS: $3.00

This paper contains data on the physical and mechanical properties of stainless steel, with regard to planning, design, fabrication, or inspection of stainless-steel equipment and its production processes. These are the main objectives of the study: "Classification and Characteristics of the Stainless Steels"; "Composition and Properties"; "Resistance to Corrosion, Oxidation, and Radiation"; "Structure"; and "Fabrication." G.G.

N64-33078* Battelle Memorial Inst., Columbus, Ohio
AN INVESTIGATION OF MECHANICAL PROPERTIES OF CHROMIUM, CHROMIUM-RHENIUM, AND DERIVED ALLOYS
A. Gilbert, B. C. Allen, and C. N. Reid Washington, NASA, Nov. 1964 61 p refs
(Contract NASw-101)
(NASA-CR-118) OTS: $1.75

The mechanical properties of chromium, molybdenum, and tungsten are radically changed by the addition of rhenium in a solid solution. The low-temperature ductility is improved by the rhenium-alloying effect, and some evidence was found that the solubility of interstitial impurities increases. Some tentative conclusions regarding the hypothesis of ductilizing factors of rhenium alloying are presented. G.G.

N64-33085* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECTS OF PURITY AND STRUCTURE ON RECRYSTALLIZATION, GRAIN GROWTH, DUCTILITY, TENSILE, AND CREEP PROPERTIES OF ARC-MELTED TUNGSTEN
William D. Klopp and Peter L. Raffo Washington, NASA, Nov. 1964 49 p refs
(NASA-TN-D-2503) OTS: $1.25

The properties of five lots of arc-melted tungsten have been characterized by chemical analyses, recrystallization and grain growth behavior, low-temperature ductility, and high-temperature tensile and creep studies. Purity appears to affect the recrystallization and grain growth rates, while structure

exerts the predominant influence on high-temperature tensile and creep properties. The low-temperature tensile ductilities of stress-relieved materials showed the usual decrease in ductile-brittle transition temperature with increasing amounts of prior work. Limited tensile and bend data on recrystallized materials showed no discernible effect of purity, structure, or annealing temperature on the ductile-brittle transition temperature. The tensile properties of arc-melted tungsten at 2500° to 4140° F were significantly affected by structure, the fine-grained materials being stronger than coarse-grained materials. Author

N64-33090 Atomic Energy Commission, Washington, D.C.
NUCLEAR FUELS AND MATERIALS DEVELOPMENT
William L. R. Rice, ed. Jul. 1964 307 p refs
(TID-11295, 3rd ed.) OTS: $7.00

A summary of work done to increase the capability of reactor materials and to define their use limitations under expected reactor conditions is presented. The summary is divided into the following areas: (1) fuel and fertile materials—metallic, ceramic, and research reactor fuels development; (2) cladding and structural materials—radiation effects on cladding and structural materials, beryllium, chromium, hafnium, iron-base alloys, niobium, yttrium, zirconium, and refractory metals, and alloys; and (3) moderator materials—beryllium oxide, graphite, and materials testing. P.V.E.

N64-33097* Pressure Technology Corp. of America, Woodbridge, N.J.
AN INVESTIGATION OF FLUID EXTRUSION OF METALS Second Quarterly Report, Oct. 1–Jan. 1, 1964
Alfred Bobrowsky 1 Jan. 1964 20 p refs
(Contract NASw-742)
(NASA-CR-58946) OTS: $1.00 fs; $0.50 mf

Deformation-under-pressure tests have been conducted on nickel-base TAZ-8, series 300 maraging steels, magnesium oxide, tungsten–4.5% tantalum alloy, and chrome–magnesia composite. The results are given, as well as some interpretation of them. Author

N64-33122* Ilikon Corp., Natick, Mass.
BASIC STUDIES ON DISPERSION HARDENING Quarterly Report, 12 Apr.–11 Jul. 1964
L. J. Bonis 28 Jul. 1964 11 p
(Contract NASw-726)
(NASA-CR-59215) OTS: $1.00 fs; $0.50 mf

Research in the following three fields is discussed: (1) the measurement of strains using transmission electron microscopy; (2) the measurement of strains using X-ray diffraction line broadening; (3) the effect of high-temperature anneals on internal structure and, in particular, on agglomeration. P.V.E.

N64-33136 Atomic Energy of Canada Ltd., Chalk River, Ontario Chalk River Nuclear Labs.
DEVELOPMENT OF ZIRCONIUM–NIOBIUM ALLOYS
C. E. Ells, S. B. Dalgaard, W. Evans, and W. R. Thomas [1964] 16 p refs Presented at 3rd Intern. Conf. on the Peaceful Uses of Atomic Energy, Geneva, 31 Aug.–9 Sep. 1964
(AECL-2022) Available from Atomic Energy of Canada, Chalk River: $0.50

The best combination of strength, ductility, and corrosion resistance found thus far for the Zr-Nb alloys is given by the following heat treatments: (1) Zr-2.5wt%Nb—water quench from 850° to 880° C and age 6 to 24 hr at 500° C; and (2) Zr-2.5wt%Nb-0.5wt%Cu—water quench from 825° to 850° C and age 6 hr at 535° C. In comparison with cold-worked (16%) Zircaloy-2 and using 300° C as a reference temperature, the heat-treated Zr-Nb alloys have tensile strengths 50% higher with equivalent ductility, have creep strengths higher by 50%, absorb more energy at fracture in impact tests, and undergo a less deleterious effect on the tensile ductility from neutron irradiation. In addition, the impact properties of the Zr-2.5wt%Nb alloy remain superior or equal to those of Zircaloy-2 after equivalent combinations of hydrogen addition and irradiation. Author

N64-33157* Hanford Atomic Products Operation, Richland, Wash.
A STUDY OF TUNGSTEN-TECHNETIUM ALLOYS Quarterly Progress Report, 1 Apr.–1 Jul. 1964
14 Jul. 1964 7 p Sponsored by NASA
(Contract-AT(45-1)-1350)
(NASA-CR-58966; HW-83550) OTS: $1.00 fs; $0.50 mf

The objectives of the work were to recover technetium from fission-product wastes and to reduce it to purified metal; to prepare W-Tc alloys containing up to 50 a/o Tc; to fabricate the alloy ingots to sheet stock, assessing the effect of technetium on workability; and to perform metallurgical and mechanical property evaluation of the fabricated alloys. Isolation from 23 000 gallons of Purex plant wastes was made of 800 grams of technetium prepared from fission product Tc-99, and was carried out in four stages. These stages included two anion exchange cycles, followed by preparation of pure ammonium pertechnetate and by reduction of ammonium pertechnetate to metal in a hydrogen furnace. A.W.

N64-33191* Franklin Inst., Philadelphia, Pa.
[AN INVESTIGATION OF THE EFFECT OF NUCLEATION OF SLIP AT THE SURFACE ON THE FLOW AND FRACTURE OF BERYLLIUM] Quarterly Progress Report, 22 Apr.–21 Jul. 1964
H. Conrad and Alan Lawley 11 Aug. 1964 3 p refs
(Contract NASr-145)
(NASA-CR-58979; Q-B2028-7) OTS: $1.00 fs; $0.50 mf

The dislocation substructure in single crystals of high-purity beryllium was studied after cyclic stressing. Specimen orientations were selected to favor basal or prism slip. The dislocation substructure associated with fatigue differed from that found after uninterrupted tensile deformation in two respects: (1) Dislocations are more uniformly distributed in the slip plane after fatigue, and there is a relative absence of dense bundles in dislocations having a large edge component, as seen following tensile strain. (2) Fatigued specimens contain very large numbers of dislocation loops, approximately 300 Å in diameter. The loops appear to lie in the basal plane. Since the loops are not observed to move on the basal plane, and have a component of their Burgers' vector out of this plane, they are sessile in nature. The very large extinction distances in beryllium make it difficult to determine whether or not the loops contain stacking faults. The dislocations are heavily jogged and pinned by the loops, implying that the loops significantly influence the hardening of beryllium. R.L.K.

N64-33194* Aerojet-General Corp., Azusa, Calif.
BIBLIOGRAPHY ON LIQUID METALS TECHNOLOGY OF Hg, K, Na, AND NaK
P. L. Studt, I. M. Rehn, and J. T. Jouthas Sep. 1963 471 p refs *Its* Rept.-2550
(Contract NAS5-417)
(NASA-CR-59028) OTS: $7.71 fs; $2.25 mf

This annotated bibliography includes items on corrosion fundamentals; containment materials; liquid metals; effect of

design and fabrication parameters on corrosion by liquid metals; effect of loop operation on performance; loop components; and techniques of corrosion testing. A.W.

N64-33241 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
STRESS CORROSION CRACKING OF TYPE 304 STAINLESS STEEL Status Report, Mar. 1, 1964
Mc Intyre R. Louthan, Jr. Aug. 1964 26 p refs
(Contract AT(07-2)-1)
(DP-907) OTS: $0.50

Stress-corrosion cracking of type 304 stainless steel exposed in dilute chloride solutions is being investigated in attempts to develop a fundamental understanding of the phenomenon. This report describes the status of the stress-corrosion studies that relate microstructure and dislocation substructure to transgranular stress-corrosion cracking. Observations are reported showing that transgranular stress-corrosion cracking, particularly during initial stages, occurs preferentially on the [111] family of planes and that such cracking most probably occurs by preferential chemical attack at lattice defects. Author

N64-33247 Bureau of Mines, Norris, Tenn. Norris Metallurgy Research Lab.
METALLIC BINDERS FOR ZIRCONIUM DIBORIDE: CHROMIUM, MOLYBDENUM, AND TUNGSTEN
Miles E. Tyrrell and Clarence W. Houck 1964 18 p refs
(BM-RI-6549)

Mixtures of zirconium diboride and refractory metals of group VI were resistance sintered to high-density compacts using modified electric welding equipment. To evaluate the use of chromium, molybdenum, or tungsten as binders for zirconium diboride the sintered compacts were examined in polished sections and tested for crushing strength, hardness, microhardness, oxidation rate, and resistance to mechanical shock. Chromium yielded the highest compressive strength, the greatest resistance to mechanical shock and oxidation, and a satisfactory Rockwell hardness. Molybdenum did not yield a satisfactory cermet. Tungsten yielded compacts having microhardness but very low mechanical strength. Author

N64-33269 Franklin Institute, Philadelphia, Pa. Franklin Inst. Labs.
BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. A STUDY OF THE BRITTLE BEHAVIOR OF BERYLLIUM BY MEANS OF TRANSMISSION ELECTRON MICROSCOPY Technical Documentary Report, 1 Jul. 1960–Mar. 1963
F. Wilhelm and H. G. F. Wilsdorf Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 62 p refs
(Contract AF 33(616)-7065)
(ASD-TDR-62-509, Vol. IV; AD-606666)

Glide dislocations in beryllium specimens were studied by direct observation with an electron microscope. The procedures are described by which specimens were heat treated and deformed, as well as the technique used to obtain electron-transparent specimens from bulk beryllium. Investigations made on polycrystalline Pechivey flake beryllium, on commercial purity single crystal plates, and on high purity single crystal tensile specimens are described. Author

N64-33272 Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.
NOTE ON THE TRANSIENT OSCILLATIONS OF A SYSTEM INCORPORATING HYSTERETIC DAMPING Technical Documentary Report, Jan–Apr. 1964
D. I. G. Jones Jul. 1964 14 p refs
(ML-TDR-64-244; AD-606121)

The motion of a single degree of freedom viscoelastic system subsequent to an initial impulse is discussed. The logical difficulties inherent in the extension of the "complex modulus" concept to transient motions are highlighted but it is shown that for currently available materials, for which the loss factor μ rarely exceeds 0.5, these difficulties do not arise. It is found that no solution exists for $\mu > 1$. Author

N64-33289* Southwest Research Inst., San Antonio, Tex.
DEVELOPMENT OF WELDING TECHNIQUES AND FILLER METALS FOR HIGH STRENGTH ALUMINUM ALLOYS; Annual Summary Report, 27 Jun. 1963–27 Jun. 1964
N. G. Lenamond, K. K. Speirs, H. C. Burghard, Jr., and Jose Mc Donald, Jr. 10 Aug. 1964 166 p refs
(Contract NAS8-1529)
(NASA-CR-59243) OTS: $5.00 fs; $1.00 mf

An investigation was undertaken to study the phases formed in the weld joint of 2219-T87 aluminum with 2319 aluminum filler metal. Of equal importance was a study of the variation in mechanical properties across the welded joint. The predominant intermetallic phase occurring in the various zones of a 2219-T87 aluminum weldment is $CuAl_2$. In most of the weld deposits, this phase occurs in the grain boundaries and is discontinuous. However, in the toes of the welds, it appears as a continuous network and takes on the appearance of Chinese script. This $CuAl_2$ Chinese script network is brittle and causes early failure of weldments due to its limited ductility. In some cases a needlelike structure was found associated with the Chinese script network. It is suspected but not confirmed that the needles are β (Al-Cu-Fe). This phase is also thought to be brittle but because it occurs in limited amounts is not believed to be as detrimental as the $CuAl_2$ network. Author

N64-33295 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
THE PRODUCTION OF POWDER-METALLURGY TUNGSTEN SHEET AND PLATE
D. J. Maykutch 20 Jul. 1964 18 p refs
(Contract AF 33(615)-1121)
(DMIC-Memo-195; AD-606053)

A brief review and analysis are presented of the tungsten sheet rolling program. Emphasis is placed on detailing the procedures that were evolved for the production of 113 plates and sheets of various gages. These materials are now being evaluated for physical and mechanical properties, as well as for formability characteristics. Author

N64-33343 Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS OF STAMPING SINTERED ALUMINUM POWDER SHEET
G. S. Sakharov et al 21 Oct. 1964 12 p Transl. into ENGLISH from Kuznechno-Shtampovochnoye Proizv. (Moscow), no. 7, Jul. 1964 p 16–18
(JPRS-27004; TT-64-51260) OTS: $1.00

This article pertains to a new high-temperature sheet material made from sintered aluminum powder (SAP), and its practical application in machine building. The SAP materials exceed the properties of ordinary forging aluminum alloys under operating conditions of evaluated temperatures, but they possess a low deductive and poor stamping ability in plastic deformations. Experiments with cladding layers improved the drawing, bending, and flanging properties of SAP sheet containing 7.5% aluminum oxide. G.G.

N64-33347 Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM QUANTITIES OF YTTRIUM IN TANTALUM
R. G. Bryan, G. R. Waterbury, and C. F. Metz 1 Aug. 1964 14 p refs
(Contract W-7405-ENG-36)
(LA-3133) OTS: $0.50

Trace concentrations (3 to 15 ppm) of yttrium in tantalum are separated by precipitation as yttrium trifluoride and determined spectrophotometrically as the Arsenazo I complex. A 5-gram sample of tantalum is dissolved in hydrofluoric and nitric acids, converting the yttrium to its insoluble trifluoride. This precipitate is separated by centrifuging and then converted to the soluble perchlorate salt in fuming nitric and perchloric acids. The yttrium complex is developed in a boric acid–Arsenazo I solution, and its absorbance is measured at 570 mμ. Relative standard deviations calculated from 14 or more determinations each of 14μg, 28μg, 42μg, and 71μg of yttrium were 13%, 5%, 9%, and 6%, respectively. Several metals, including calcium, lead, thorium, zirconium, and the lanthanides, interfere seriously in this method. Author

N64-33364 David Taylor Model Basin, Washington, D.C. Structural Mechanics Lab.
EVALUATION OF COMMERCIALLY PRODUCED HY-80 STEEL
A. R. Willner and M. L. Salive Jul. 1964 43 p refs
(DTMB-1850; AD-444806)

The purpose of this investigation was to obtain a better understanding of some of the variables that may affect the properties of HY-80 steel. The data indicate that hardenability is increased with plate thickness. Generally, plates above 3 in. thick contain less than 80% martensite. As the percent martensite decreases, so do the Charpy V-notch impact values at −120° F. Author

N64-33367 Brown U., Providence, R.I.
AN APPLICATION OF THE REVERSED BEND TEST TO INVESTIGATE THE EXHAUSTION OF DUCTILITY OF THREE MODERATELY HIGH-STRENGTH STEELS
Garry J. Patterson Jun. 1964 34 p refs Sponsored by ARPA
(AD-444554)

The reversed bend test entails bending a steel bar specimen far into its plastic range (thereby subjecting the intrados to compression), after which the maximum strain on the intrados is measured. Application of a tensile force to the ends of the specimen and a determination of the mode of behavior conclude the test. The ductility of the steels, as measured by the reversed bend method, is exhausted in a relatively short range of compressive prestrain for most of the conditions under which the specimens were tested. The effects produced on the ductile-to-brittle transition region by aging, by low-specimen temperature during the reversed bend, by varying the bend mode, and by variation of steel composition are demonstrated. P.V.E.

N64-33373 Crucible Steel Co. of America, Pittsburgh, Pa.
FRACTURE MICROMECHANICS IN HIGH-STRENGTH STEELS AND TITANIUM Technical Documentary Report, 15 Dec. 1962–15 May 1964
B. R. Banerjee and J. J. Hauser Wright-Patterson AFB, Ohio, AF Mater. Lab., 31 Jul. 1964 266 p refs
(Contract AF 33(657)-10337)
(ML-TDR-64-182; AD-607048)

To characterize the structural factors that govern the heterogeneous micromechanics of flow and fracture in high-strength materials, a variety of high-strength steels and a high-strength titanium alloy were investigated in detail. Among the alloys studied were AISI 4340, a low-alloy high-strength steel; Type H-11, a secondary-hardening hot-work steel; Types 410 and 422, martensitic stainless steels; Type 301, a deformation-strengthened steel; Type PH15-7Mo, a precipitation hardened semiaustenitic steel; 300-grade 18-Ni marage steel; Cr-Co stainless marage AFC-77; and B-120VCA, an age-hardened beta-titanium alloy. In these materials, the detailed fine structures are characterized and related to strength and fracture properties. Author

N64-33427 Fansteel Metallurgical Corp., North Chicago, Ill. Metal Products Div.
COLUMBIUM ALLOY SHEET ROLLING PROGRAM Final Report, 7 Mar. 1963–1 Sep. 1964
H. L. Kohn and R. M. Curcio Oct. 1964 54 p refs
(Contract NOw-63-0231-c)
(AD-606291)

Six-inch-diameter, 300-lb ingots of FS-85 (Cb-27Ta-10W-1Zr) and B-66 (Cb-5V-5Mo-1Zr) were processed to produce 0.060-in × 18-in.-wide sheet. The FS-85 was successfully converted to target dimensions while the B-66 sheets did not meet the 18-in.-width criteria. The finished sheet was evaluated with respect to chemical and mechanical properties and weldability. The ingot to sheet yield for FS-85 was 51.1% while the yield for B-66 was only 21.5%. The room-temperature and elevated-temperature strengths of B-66 were higher than FS-85. The creep-rupture strength of B-66 was superior to FS-85 at 2000° F, but the FS-85 exhibited higher creep strength at 2400° F and 2600° F. Base metal bend transition temperatures were found to be less than −320° F for both 1T and 4T radii bends for FS-85 metal. The B-66 exhibited a 1T and 4T radii bend transition temperature of less than −320° F when material in the stress-relieved condition was tested. Author

N64-33436 Bureau of Mines, Albany, Ore. Metallurgy Research Center
SOME EFFECTS OF YTTRIUM AND RARE-EARTH-METAL ADDITIONS ON ELECTROREFINED VANADIUM
W. L. O'Brien and E. A. Rowe 1964 28 p refs
(BM-RI-6553)

Electrorefined vanadium with additions of up to 5% by weight of yttrium, cerium, lanthanum, praseodymium, neodymium, and samarium was melted to ingots in a nonconsumable electrode arc in a helium atmosphere. The ingots were rolled into strips and evaluated for the effect of the alloying elements on hardness, tensile strength, ductility, recrystallization temperature, and microstructure. Except for samarium, average additions of alloying elements of 1 to 2 wt.% resulted in the retention of 0.12 to 1.05 wt.% in the alloys and reduced the ultimate tensile strength from about 48 000 to approximately 30 600 psi. The corresponding yield stress (0.2 percent offset) was reduced from about 40 700 to approximately 20 200 psi. Diamond pyramid hardness (DPH) was reduced from 117 to an average of 62 kg/mm^2. Author

N64-33442 Boeing Co., Renton, Wash. Transport Div.
DIFFUSION STUDIES UTILIZING HIGH FREQUENCY INTERNAL FRICTION
J. H. Adams 15 Jul. 1963 63 p refs
(D6-9586TN)

The study is involved in establishing a high-frequency technique for the measurement of internal friction and the use of this facility in the study of hydrogen and carbon movements in steel. In the carbon migration studies, the movements of

carbon were studied in the 75° to 700° F temperature range in as-quenched steels. The hydrogen studies were performed on cathodic, charged high-strength steel specimens. Author

N64-33450 Midwest Research Inst., Kansas City, Mo.
THE STRUCTURE AND STRENGTH OF EPITAXIAL FILMS Bimonthly Progress Report, 17 Jun.–17 Aug. 1964
Melvin Lavik, Paul Stablein, and Paul J. Bryant 25 Sep. 1964 7 p
(Contract NOw-64-0061-d)
(BPR-5; AD-602490)

The main effort has been the design of a tensile device to facilitate stress–strain measurements on free epitaxial films and the development of techniques for removing the substrate from such films. In addition the evaporation oven has been rebuilt so that only the inner wall of the crucible is exposed to uhv. Lower operating pressures may now be maintained during evaporation. Gold films have been deposited on aluminum, silver, NaCl, and mica crystals, and their structure is being studied. Author

N64-33461 Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
EQUILIBRIUM STRUCTURES IN THE HIGH URANIUM-SILICON ALLOY SYSTEM Topical Report
J. A. Straatmann and N. F. Neumann 23 Oct. 1964 21 p refs
(Contract W-14-108-ENG-8)
(MCW-1486) OTS: $1.00

The boundaries and phase fields existing in uranium alloys containing from 30 to 3000 ppm by weight silicon at temperatures ranging from 500° to 1200° C have been determined from differential thermal, metallographic, and microprobe analyses. The phase diagram and the methods used to determine it are included, as well as micrographs of the studied specimens. Author

N64-33464 Bureau of Mines, Reno, Nev. Metallurgy Research Center
RECRYSTALLIZATION OF VANADIUM
E. A. Loria, W. D. Ludemann, and E. A. Rowe 1964 43 p refs
(BM-RI-6547)

The isothermal recrystallization of electrorefined vanadium was studied as a function of annealing time, temperature, and prior deformation. The defining of recrystallization limits with respect to the amount of deformation was precisely established for electrorefined vanadium. Recrystallization by the mechanism of nucleation and growth was the principal process during the second stage of softening. Grain growth was expressed by the empirical relation $D = Kt^n$, the exponent being the same at 60-percent reduction and annealing from 750° to 900° C. Accordingly, the activation energy for grain growth was 75 000 cal per mole. Author

N64-33499 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
TUNGSTEN AND TUNGSTEN-BASE ALLOYS Review of Recent Developments
V. D. Barth 30 Oct. 1964 4 p refs

Reviewed are consolidation and fabrication processes, reported mechanical behavior, physical metallurgical studies, structural applications, and oxidation investigations. R.L.K.

N64-33509 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
POWDER METALLURGY Review of Recent Developments
D. E. Lozier and D. E. Kizer 23 Oct. 1964 3 p refs

The recent developments discussed include the following: (1) powder compaction—comparison of the compressibilities of minus 100-mesh aluminum and electrolytic iron and minus 325-mesh copper and tungsten powders using conventional and isostatic techniques; (2) hot pressing and sintering—investigation of the consolidation of refractory-metal alloys W-10Mo-10Cb and W-20Ta-12Mo by hot pressing; and (3) plasma spraying and slip casting—development of three methods for bonding plasma-jet-sprayed tungsten to steel. P.V.E.

N64-33532 AiResearch Mfg. Co., Phoenix, Ariz.
MATERIALS INVESTIGATION, SNAP 50/SPUR PROGRAM, PART I. CREEP-RUPTURE PROPERTIES OF STRESS-RELIEVED TZM ALLOY Technical Documentary Report, Jun. 1963–Apr. 1964
R. L. Salley and E. A. Kovacevich Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 36 p refs
(Contract AF 33(657)-10922)
(APS-5092-R; APL-TDR-64-116, Pt. I; AD-607274)

The results of experimental investigations to determine the effect of potassium on the creep-rupture properties of the TZM alloy are presented. The tests were conducted at 1800° and 2000° F, with and without exposure to saturated potassium vapor. The results indicated that the creep-rupture behavior was not influenced significantly by exposure to potassium vapor for periods of approximately 1000 hours. However, some mass-transfer-type corrosion was observed. This signifies that it is dangerous to extrapolate the results of this study to 10 000 hours, because progressive mass transfer might eventually cause accelerated creep and premature failure. Author

N64-33585 Naval Ordnance Test Station, China Lake, Calif. Research Dept.
EFFECTS OF ULTRASOUND ON DEFORMATION CHARACTERISTICS OF STRUCTURAL METALS, 1 JULY 1963–30 JUNE 1964. PART I: APPLICATION OF PHOTOELASTICITY Technical Progress Report 371
W. H. Frandsen and J. A. M. Langenecker Aug. 1964 13 p refs
(NOTS-TP-3622; AD-446394)

Intense ultrasound having power levels up to 100 W/cm^2 at 20 kc is used in studies of mechanisms of metal deformation and treatment. To provide accurate quantitative information about the underlying experimental conditions, this report describes detailed investigations of modes of propagation of intense ultrasonic stress waves in rods and bars. Measurements of conversion of acoustic energy into heat and kinetic energy of lattice imperfections are discussed. Experiments in which high strain rate tensile tests and intense pulsed ultrasound were applied are illustrated. Ultrasonic metal deformation is also discussed. Author

N64-33603 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
TENSOR PROPERTIES OF ORIENTED METALS
E. F. Sturcken and J. W. Croach Oct. 1964 18 p refs
(Contract AT(07-2)-1)
(DP-927) OTS: $1.00

The theory for predicting anisotropic physical properties that result from preferred grain orientation was generalized, in analogy to the theory of linear homogeneous strain, to permit prediction of physical properties in all directions of the material from preferred orientation measurements in six or more directions. The theory is applicable to those properties that can be described to a first approximation by a second-order tensor, such as electrical resistivity, thermal coefficient of linear expansion, heat conductivity, thermal emf, magnetic susceptibility, and irradiation growth. Author

N64-33665 Ohio State U. Research Foundation, Columbus
INITIAL STAGES OF OXIDATION OF METALS Progress Report, 1–31 Jul. 1964
M. Goldberg 8 Sep. 1964 2 p *Its* Rept-1
(Contract DA-31-124-ARO(D)-242; Grant DA-ARO(D)-31-124-G470)
(AROD-4397-2; AD-606776)

Results of a study of the initial stages of oxidation of molybdenum at temperatures less than 1000° K are similar to those obtained earlier for tungsten and tantalum. Preliminary observation of the reaction of oxygen with molybdenum at uninterrupted elevated temperatures from 300° to 1000° K, using a recently acquired high-voltage dc pulsing unit, is also reported. M.P.G.

N64-33681* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
CORROSION OF MATERIALS BY REFLUXING MERCURY AT TEMPERATURES ABOVE 1000°F
Coulson M. Scheuermann, Charles A. Barrett, Warren H. Lowdermilk, and Louis Rosenblum [1964] 20 p Presented at Wash. Meeting of the Electrochem. Soc., Wash., D.C., 11–15 Oct. 1964
(NASA-TM-X-54787) OTS: $1.00 fs; $0.50 mf

The compatibility of various materials with mercury was determined for their possible use in contemporary space turboelectric power systems. Twenty-four materials were selected for testing from the following categories—austenitic stainless steels, martensitic chromium steels, cobalt base alloys, nickel base alloys, and refractory metals and alloys. Test results and materials are discussed with respect to compatibility, strength, and development problems associated with space systems. Corrosion rates were determined for several alloys. These are discussed and compared with existing theory. Author

N64-33752 Climax Molybdenum Co. of Michigan, Detroit
THE DEVELOPMENT AND EVALUATION OF TUNGSTEN-BASE ALLOYS Progress Report, 10 Apr.–10 Jul. 1964
M. Semchyshen, Robert Q. Barr, and Eric Kalns [1964] 15 p
(Contract NOw-64-0057-c)
(AD-445063)

Wrought bar stock was obtained from eight of nine vacuum-arc-cast tungsten-base alloys subjected to the extrusion process. Two attempts to extrude the W + 0.25% Hf + 0.02% C alloy stalled the press. Recrystallization characteristics of the extruded materials have been initiated. Solution treatment studies and the preparation of tensile test specimens are now in progress. Author

N64-33794 United States Steel Corp., Monroeville, Pa. Applied Research Lab.
EFFECTS OF COMPOSITION ON THE TRANSFORMATION CHARACTERISTICS AND TOUGHNESS OF WELD-HEAT-AFFECTED ZONES IN MI-Cr-Mo STEELS
L. P. Connor, A. M. Rathbone, and B. K. Stewart 1 Apr. 1964 38 p refs
(Contract NObs-88540)
(AD-600933) OTS: $2.00

As part of the program to define the composition limits within which an HY-130/150 steel would exhibit satisfactory weldability, the effects of carbon (0.05% to 0.21%), manganese (0.3% to 1.5%), phosphorus (0.003% to 0.027%), sulfur (0.003% to 0.027%), and nickel (1% to 9%) on the crack susceptibility, transformation characteristics, and toughness of the weld-heat-affected zone were determined on 32 statistically selected Ni-Cr-Mo steels. Author

N64-33861 Naval Weapons Lab., Dahlgren, Va. Warhead and Terminal Ballistics Lab.
ALTERATION OF THE MECHANICAL PROPERTIES OF SIXTEEN METALS BY EXPLOSIVE INDUCED STRESS WAVES; COMPOSITION H-6 EXPLOSIVE, OBLIQUE SHOCK
Lester A. Potteiger 10 Jul. 1964 33 p refs
(NWL-1930; AD-445107)

Results are given of sixteen experimental tests to investigate the alteration of the mechanical properties of metals by detonation of Composition H-6 explosive in direct contact. An oblique stress wave of approximately 175 to 200 Kb peak pressure and 12 μsec duration was induced in test specimens of nickel and nickel alloys, a cobalt alloy, and several ferrous alloys. Results of hardness, tensile, and impact tests, both before and after explosive loading, are given along with other pertinent information on the properties of the metals and the test procedure. Author

N64-33873 Massachusetts Inst. of Tech., Cambridge
DEFORMATION PROCESSING OF ANISOTROPIC METALS Progress Report, 1 Mar.–30 Apr. 1964
D. H. Avery and W. A. Backofen Jul. 1964 5 p
(Contract NOw-63-0564-d)
(PR-5; AD-603637) OTS: $1.00

The yield locus for the 3/16-in.-thick sheet of 4% Al-1/4% O_2 α-titanium alloy was determined, and the complete yield-locus diagram is included. A discrepancy is noted in the compression-compression quadrant between experiment and theory, and it is attributed to {1012} mechanical twinning under compression stresses acting more or less normal to the C axis in the sharply textured sheet. Plastic anisotropy in the same material when rolled an additional 66% was also investigated. Plastic strain ratios for both sheets after various axial strains are tabulated. D.E.W.

N64-33881 Marine Engineering Lab., Annapolis, Md.
DEVELOPMENT OF TITANIUM ALLOYS FOR HULLS OF DEEP-DIVING VEHICLES
I. R. Lane, Jr. 31 Aug. 1964 52 p refs
(MEL-194/64; AD-446416)

The program was aimed at obtaining near-alpha-type alloys with good toughness and fabricability at a yield strength of 120 ksi. A minor effort was also made to explore higher-strength alloys. Several alloys approached the target properties, but not with consistency. The lack of consistency was associated with inadequate knowledge of optimum mill-processing schedules and physical-metallurgy kinetics. Study of these aspects is now underway. At least one alloy (Ti-7Al-2Cb-1Ta) can now be considered satisfactory, at a minimum yield strength of 105 ksi, for research-type submersibles. Author

N64-33893 Wisconsin U., Madison
MECHANISM OF STRESS-CORROSION CRACKING IN FACED-CENTERED-CUBIC METALS Final Technical Report
R. A. Dodd [1963] 8 p refs
(Grant AF-AFOSR-61-68)
(AFOSR-J1128; AD-421724)

This is a study of dislocation configurations, stacking faults, and energies of long- or short-range order in the stress-corrosion cracking of face-centered-cubic metals. The stress corrosion of copper–gold single crystals and silver–gold single crystals was observed. An electrochemical evidence of stress-corrosion association with oxide films was found, and the necessity of both surface films and planar dislocation structures to produce stress corrosion are pointed out. G.G.

N64-33898 Watervliet Arsenal, N.Y. Benet R&E Labs.
A STUDY OF THE WELD HEAT-AFFECTED ZONE OF CENTRIFUGALLY CAST FIVE PERCENT CHROMIUM STEEL
Keh Chang Wu Dec. 1963 29 p refs
(WVT-ID-6316; AD-602052)

The weldability of centrifugally cast 5% chromium steel was investigated by using a hot ductility and synthetic heat-affected zone technique. Ductility of the specimen was greatly reduced above 2400° F for the "on-heating" test. However, after heating to a detrimental temperature of 2500° F and cooling to 2400° F, ductility almost recovered its original value. Therefore, hot-cracking is not considered likely. The microstructure in the heat-affected zone at various locations was reproduced in Charpy impact test specimens that were later tested at various temperatures ranging from −60° to +212° F. The result showed that a specimen thermally cycled at an 1800° F peak temperature gave the lowest impact strength. The X-ray diffraction and electron micrography revealed the existence of retained austenite that decomposed during tempering treatment. Author

N64-33908 Nuclear Metals, Inc., Concord, Mass.
BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM Technical Documentary Report, 17 Jun. 1959–1 Oct. 1963
E. D. Levine, J. P. Pemsler, and S. H. Gelles Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 96 p refs
(Contract AF 33(616)-7065)
(ASD-TDR-62-509, Vol. III; AD-606667)

Efforts to produce the purest beryllium possible by double vacuum distillation are described. The distilled beryllium when converted to powder and subsequently extruded exhibited greater bend ductility than any of the other forms of less pure beryllium utilized in the evaluation. The work involves the evaluation of the ductility and critical resolved shear stress for basal slip of cast single crystals of Pechiney SR grade and single distilled beryllium. The data were compared with previous work on cast commercial grade and zone-refined single crystals. Attempts were made to achieve finer grain size powder than had ever been produced, while minimizing contamination. The powder of particle sizes less than 5μ was produced by improved attritioning methods. Powder sizes of approximately 300 Å were achieved by evaporation and condensation. Author

N64-33914 Rutgers U., New Brunswick, N.J. Materials Research Lab.
DUCTILE-BRITTLE TRANSITION IN REFRACTORY METALS Technical Documentary Report, Mar. 1, 1963–May 31, 1964
T. Ellis and S. Weissmann Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 51 p refs
(Contract AF 33(657)-10872)
(ML-TDR-64-220; AD-607001)

An X-ray method is described that permits a precise determination of the interplanar spacings in a crystal. The method is capable of disclosing small differences in interplanar spacings even between various sets of (hkl) planes of the same form and therefore, serves as a basis for a stress–strain analysis. An error analysis shows that the minimum measurable strains in the lattice, expressed as $\Delta d/d$, are a function of the diffraction angle θ. For θ varying from 35° to 65° the minimum measurable strains vary from 0.3% to 0.009%. The results of the stress–strain analysis at 298° and 77° K show a close correlation between the maximum shearing strains obtained experimentally and the resolved shear stress factor. The buildup of shearing strains is attributed to dislocation multiplication and interaction on active slip planes. Author

N64-33927 Materials Research Corp., Orangeburg, N.Y.
THE RECRYSTALLIZATION KINETICS OF HIGH PURITY IRON Final Technical Report, 1 Oct. 1962–1 Oct. 1963
E. J. Hughes, P. W. Barton, A. A. Johnson, and G. Abowitz Wright-Patterson AFB, Ohio, ARL, Aug. 1964 28 p refs
(Contract AF 33(657)-9852)
(ARL-64-131; AD-607236) OTS: $0.75

Measurements were made of the isothermal recrystallization kinetics of electron-beam zone refined iron. The principal impurities in this material were tungsten, carbon, nitrogen, oxygen, and hydrogen that together totaled approximately 50 ppm. The results are interpreted in terms of a theory of solute limited grain-boundary migration recently proposed by Cahn (1962). According to this interpretation the boundary velocity at low velocities is determined principally by drag due to the tungsten impurity atoms, while at high velocities it is determined principally by the other four species of impurities. Some evidence tending to support these conclusions was obtained by repeating the measurements on similar material to which extra carbon had been added. This had the effect of slowing down the grain boundary migration more in the high velocity region than in the low. Author

N64-33948 Southern Research Inst., Birmingham, Ala.
MECHANICAL AND PHYSICAL PROPERTIES OF TZM MOLYBDENUM ALLOY SHEET AND OF TUNGSTEN SHEET Quarterly Progress Report, May 1–Aug. 31, 1964
Clifford L. Dotson and P. G. Adams 30 Sep. 1964 43 p
(Contract N-600(19)-59530)
(QPR-7; AD-606310)

Tensile tests were conducted on recrystallized 0.060-in. and 0.100-in. tungsten sheet from room temperature up to 3500° F. Notched and unnotched tensile tests were conducted on the 0.060-in. tungsten sheet in the optimum and recrystallized conditions at moderately elevated temperatures (900° F and below) to determine the notched–tensile, brittle–ductile transition temperature. Tensile tests were completed on the 0.020-in., 0.040-in., and 0.060-in. TZM sheet in both optimum and recrystallized conditions, at temperatures ranging from room temperature to 3000° F. Specimen preparation for future tests was continued. D.E.W.

N64-33972 Parametrics, Inc., Waltham, Mass.
USE OF KRYPTONATES IN MATERIALS RESEARCH Quarterly Progress Report
30 Jun. 1964 39 p
(Contract AF 33(615)-1268)
(AD-450355)

Excellent samples of kryptonated tantalum sheet have been obtained by ion bombardment with Kr^{85} ions. The samples have been used to determine the rate of release of Kr^{85} by the sample in flowing air and O_2 and in a static system containing O_2. The results of measurements in the flowing system show that the rate of loss of Kr^{85} is reproducible if identical samples are used. They also show that the rate of loss is very sensitive to the initial cleaning treatment given the sample. The data in the static system were obtained to simultaneously measure the rate of release of Kr^{85} and the consumption of O_2. Author

N64-34000* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio
DETERMINATION OF ELEVATED-TEMPERATURE FATIGUE DATA ON REFRACTORY ALLOYS IN ULTRA-HIGH VACUUM First Quarterly Report, 1 Jul.–1 Oct. 1964
C. R. Honeycutt and J. C. Sawyer 4 Nov. 1964 18 p refs
(Contract NAS3-6010)
(NASA-CR-54203) OTS: $1.00 fs; $0.50 mf

The purpose of this investigation is to generate fatigue data for refractory alloys at elevated temperatures in ultra-high-vacuum environments. The initial phase of the program deals with the development of test equipment that can vibrate specimens at 10 to 20 kc/sec at 1800° to 2200° F in a vacuum of 1×10^{-8} torr or better. This report describes the general design of the test equipment and presents current results on bench tests being made to study design problems in the high-frequency vibration system. Author

N64-34003 Naval Ordnance Lab., Corona, Calif. Chemistry Div.
BERYLLIUM RESEARCH PROGRAM Technical Report No. 1, Jan.–Jun. 1964
N. R. Fetter, R. H. Kratzer, K. L. Paciorek, and F. M. Peters 1 Aug. 1964 57 p refs
(NAVWEPS-8204; AD-445960)

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1. REACTIONS OF BIS-DIMETHYLAMINOBERYLLIUM WITH ALKYLALUMINUM HYDRIDES AND ALUMINUM HYDRIDE TRIMETHYLAMINE Neil R. Fetter and Frances M. Peters p 1–15

BERYLLIUM-NITROGEN CHEMISTRY
2. REACTIONS OF DIETHYLBERYLLIUM AND DIISOPROPYLBERYLLIUM WITH TETRAMETHYLTETRAZENE Neil R. Fetter p 16–23
3. TRIMETHYLAMINE COMPLEXES OF DIETHYLBERYLLIUM Frances M. Peters p 24–26

BERYLLIUM-BORON CHEMISTRY
4. REACTIONS OF BERYLLIUM BOROHYDRIDE R. H. Kratzer and K. L. Paciorek p 27–39

BERYLLIUM-PHOSPHORUS CHEMISTRY
5. INVESTIGATIONS DIRECTED TOWARD THE PREPARATION OF BERYLLIUM-PHOSPHORUS POLYMER SYSTEMS Peter J. Slota, Jr. and Frances M. Peters p 40–53 refs

N64-34021* National Aeronautics and Space Administration, Washington, D.C.
THE STATE OF CARBON IN TITANIUM, TANTALUM, AND TUNGSTEN [PRO STAN VUGLETSYU V TITANI, TANTALI TA VOL'FRAMI]
I. N. Frantsevich and I. I. Koven'skiy Nov. 1964 7 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 11, 1961 p 1471–1474
(NASA-TT-F-263) OTS: $0.50

Carbon electrotransport was investigated in titanium, tantalum, and tungsten, the carbon content being 0.1% by weight. The experimental data were used to determine the charges of the carbon ions in the given metals. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-32755 General Electric Co., Schenectady, N.Y. Research Lab.
CHEMICAL EFFECTS OF CORONA ON MATERIALS, PHASE II. PART B. CORONA EFFECTS IN COAXIAL CORONA CELLS
In its Res. on Dielectric Mater. May 1964 p 91–127 refs (See N64-32751 24-07) OTS: $5.00

From the results obtained in studying the effect of dc discharges on thin films of radioactive polyethylene-type materials, the following conclusions were reached: (1) Ion bombardment is more damaging than negative bombardment. (2) Streamer-type discharges are much more damaging than Townsend-like discharges. (3) The nature of the discharge can be changed depending on whether or not the cathode is metallic or nonmetallic, and it also can be changed by the conductivity of glass plate that is being bombarded in dc corona. P.V.E.

N64-33057 Advisory Group for Aeronautical Research and Development, Paris (France)
AN INITIAL ASSESSMENT OF GRAPHITE AS A STRUCTURAL MATERIAL IN CONDITIONS OF HIGH THERMAL FLUX
A. J. Kennedy Sep. 1960 45 p refs
(AGARDograph-51)

The state of fundamental knowledge of graphite and the graphitization process is reviewed. The principal methods of manufacture may be considered to include conventional graphitization of a coke filler-binder mix, the compaction at high pressure and temperatures of natural or artificial graphite particles without a binder, pyrolytic graphites derived from gaseous deposition, and conventional graphites impregnated by liquid or gas and regraphitized. The present state of development of these processes is examined. Author

N64-33067 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
THE FEASIBILITY OF USING CHLORINE-CONTAINING EPOXY RESINS IN ADHESIVE FORMULATIONS
William C. Tanner Jul. 1964 15 p refs
(PA-TM-1396; AD-444938)

An epoxy resin based on 2,2'-methylenebis (4-chlorophenol) was prepared. This chlorinated bisphenol was selected as a model compound for high molecular weight resins of similar structure. Epoxy resins similar in structure, with and without chlorine, were compared to determine the effect of the chlorine atom on adhesive qualities. Bond strengths were measured at −65°, 73°, and 160° F. The effect of storage at 160° F and at 90° F and 100% relative humidity was also determined. Author

N64-33137 Picatinny Arsenal, Dover, N.J. Plastics Technical Evaluation Center
SUBJECT INDEX, BIBLIOGRAPHY, AND CODE DESCRIPTION OF TECHNICAL CONFERENCE PAPERS ON PLASTICS: 28 February 1963–1 March 1964
Arnold E. Molzon Jul. 1964 118 p refs
(PLASTEC-17) OTS: $2.50

The papers presented at technical conferences on plastic materials and related technology, within a one-year period ending 28 February 1964, have been listed, indexed by subject, and compiled by material, type of technical data, and military application. Over 600 papers from 19 conferences have been covered. Included are a bibliography and an author index. An analysis of technical conference trends is also presented. Author

N64-33299 Picatinny Arsenal, Dover, N.J. Plastics Technical Evaluation Center
PLASTIC GEARS: A MEMORANDUM ON FEASIBILITY FOR USE IN AMMUNITION ITEMS
John Nardone Jul. 1964 35 p refs
(PLASTEC-16; AD-605396) OTS: $1.00

A literature survey was performed in order to determine the plastic materials and design techniques used in gear applications, with evaluation as to feasibility for use in military items. The main plastic gear materials are acetal, nylon, polycarbonate, modified polystyrene, and filled phenolic. The advantages in their use are numerous; however, there are some limitations that must be considered in designing with plastics. Two case studies are studied—one to show where plastic gears are feasible and the other to indicate an application where the design limits the use of plastic materials. Author

N64-33302 Joint Publications Research Service, Washington, D.C.
EXPERIMENTAL TECHNIQUES IN THE INVESTIGATION OF CARBON-GRAPHITE MATERIALS AT 20–3200°C
N. N. Dergunov and V. N. Barabanov 27 Oct. 1964 20 p refs Transl. into ENGLISH from Zavodsk. Lab., (Moscow), no. 8, 1964 p 997–1005
(JPRS-27097; TT-64-51353) OTS: $1.00

A critical survey of certain papers on the mechanical properties of graphite at high temperatures is reported. Questions are considered on the heating system, on the temperature measurement and adjustment system, on sample bracing, on sample form, on the loading and stress measuring system, on the deformation measurement and recording system, and on the system for measuring and recording the mechanical properties and the structure of graphite. D.E.W.

N64-33325 California Inst. of Tech., Pasadena W. M. Keck Lab. of Engineering Materials
A RESEARCH PROGRAM ON SOLID PROPELLANT PHYSICAL BEHAVIOR Quarterly Report No. 2, 1 Feb.–30 Apr. 1964
M. L. Williams May 1964 5 p ref
(Contract AF 04(611)-9572)
(MATSCIT-PS-64-2; AD-602753)

Three research projects are described: (1) behavior of polymeric and composite systems, including mechanical and electrical behavior of gum-rubber vulcanizates and kinetics of free-radical polymerization; (2) selection of a cross-linked standard polymer and parameter study of the cross-linked polymer Solithane 113; and (3) establishment of a library facility for the purpose of consolidating technical information related to the mechanical behavior of solid propellants. M.P.G.

N64-33432 American Meteorological Society, Boston, Mass.
ELECTROPHYSICAL PROPERTIES OF POLYMERIC PHTHALOCYANINES
E. I. Balabanov, E. L. Frankevich, and L. G. Cherkashina Mar. 1964 14 p refs Transl. into ENGLISH from Vysokomol. Soedineniya (USSR), v. 5, no. 11, 1963 p 1684–1690
(Contract AF 19(628)-3880)
(T-R-433; AD-602181) OTS: $0.50

Polymers of copper phthalocyanine were synthesized from pyromellitic acid and, after vacuum treatment, had an electric conductivity at 300° K of 0.001 to 0.00001 mho/cm. A mass spectrometer was used to investigate the composition of the gases released during vacuum treatment, and it was shown that the increase of specific electric conductivity that occurs in this case is associated with the removal of the oxygen-containing molecules that act as acceptors of electrons. The decrease of the specific electric conductivity of the samples left in air is associated with the adsorption of water and with the oxidation of the polymer by atmospheric oxygen. D.E.W.

N64-33522 Naval Research Lab., Washington, D.C. Mechanics Div.
EFFECT OF SURFACE TREATMENTS ON THE MECHANICAL BEHAVIOR OF FILLED RUBBER
Daniel R. Mulville and Irvin Wolock Aug. 1964 19 p ref
(NRL-Memo-1563; AD-607195)

Tests were conducted to determine the effects of high rates of loading, and of typical adhesives on the mechanical behavior of EP-87 rubber, a filled rubber used as insulation in rocket chambers. It was found that the higher rate of loading studied did not affect the brittle–ductile transition temperature, but it did make the rubber more sensitive to a surface notch. It was also found that standard epoxy adhesives applied to the surface of this material reduces the tensile elongation from approximately 200% for the control material to 1% to 2% for the coated material; reduces the Charpy impact strength from approximately 9 ft-lb for the control material to 1 to 2 ft-lb for the coated material; increases the brittle–ductile transition temperature from approximately 40° F for the control material to approximately 80° F for the coated material. Shallow surface notches or scratches have a similar effect on the impact strength and transition temperature. A flexible adhesive, however, has little or no effect on the mechanical behavior of this same material. Author

N64-33673 Borden Chemical Co., Philadelphia, Pa. Central Research Lab.
STUDY LEADING TO THE DEVELOPMENT OF REINFORCED HIGH TEMPERATURE ELASTOMERS Final Report, Sep. 1962–Sep. 1963
K. C. Tsou, S. J. Makower, R. N. Goldey, and B. D. Halpern [1963] 32 p refs

Filler–rubber systems containing various chemical modifications of silica and fibrous talc as fillers, have been evaluated at 500° F after aging at 500° F. Trimethylsilyl (TMS) silicas are more suitable than triphenyl silicas. Fibrous grades of talc were superior as nonreinforcing fillers. Best improvement was obtained with combination of TMS silica and fibrous talc modified by chlorosilanes. Additional incorporation of vinyl chlorosilane improved high-temperature elongation. Author

N64-33823 Army Engineer Research and Development Labs., Fort Belvoir, Va. Materials Research Lab.
INFILTRATION OF POROUS CERAMIC MATERIALS WITH PLASTICS
S. Goldfein 29 Jul. 1964 13 p
(Rept.-1780-TR; AD-445878)

Porous ceramics formed of clay, alumina, and mixtures of clay and alumina were infiltrated with an epoxy resin after having been placed in a vacuum. After curing with heat, the specimens were tested for compressive, flexural, and impact strength. The compressive and impact strengths were increased significantly but not greatly. The flexural strength decreased from the standpoint of the epoxy resin but increased from the standpoint of the ceramic foam. It is concluded that the process of infiltration produced a product superior in strength to the individual components but not strong enough to be classed with glass-fiber-reinforced plastics. Author

N64-33868* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CROSS CHECK STUDY OF THERMAL-VACUUM WEIGHT LOSS DETERMINATIONS FOR SELECTED POLYMERS

C. T. Egger and J. B. Gayle 13 Aug. 1964 34 p refs
(NASA-TM-X-53106) OTS: $2.00 fs; $0.50 mf

Results of a cross check study of the vacuum compatibility of selected polymers are presented. The data for polystyrene and polymethylmethacrylate are compared with results obtained by the National Bureau of Standards. The major finding was that temperature measurement methods are subject to unexpected errors and, thus, require careful evaluation. Author

N64-33871* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala
LOW-TEMPERATURE ELASTIC BEHAVIOR OF FOURTEEN COMPOUNDED ELASTOMERS
C. D. Hooper 21 Sep. 1964 49 p
(NASA-TM-X-53137) OTS: $2.00 fs; $0.50 mf

Fourteen compounded elastomers, each one at three hardness levels, were studied. These studies included modulus of rigidity, brittle temperature, Young's modulus at 10 000 psi, and relative stiffness of each compound. Graphical data are presented that illustrate the findings of these experiments. Author

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see:* 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-32744 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
LASS, AN IBM 704 PROGRAM FOR CALCULATING SYSTEM STABILITY
Sidney M. Katz and Daniel S. St. John Jul. 1964 121 p refs
(Contract AT(07-2)-1)
(DP-894)

The LASS code is an IBM 704 program to compute the stability and transient response of dynamic systems. Up to 50 system equations (in up to 50 system variables) are written in linearized form (for example, by assuming small perturbations about a steady-state operating condition). After taking Laplace transforms, a system of linear, algebraic equations is obtained in which the coefficients are polynomials in the Laplace transform variable, s. The LASS code accepts the matrix of these coefficient polynomials, reduces it to a single transfer function (ratio of polynomials in s), and calculates and plots the stability characteristics, frequency response, and transient response of the system. A sample problem from a nuclear reactor system was used to illustrate the use of the code. Author

N64-32745 Joint Publications Research Service, Washington, D.C.
COMPUTER MATHEMATICS AND ENGINEERING
G. A. Mikhaylov and V. N. Ostapenko ed. 5 Oct. 1964 168 p refs
Transl. into ENGLISH from Vychislitel'naya Mat. i Tekhn. (Kiev), 1962 p 3–104, 111–130
(JPRS-26718; TT-64-41975) OTS: $5.00

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10. ONE OF THE METHODS OF MULTIPLE CYCLE MULTIPLICATION WITH REDUCED SURPLUS IN THE MULTIPLICATION AND DIVISION MATRIX I. G. Morozp 102–111

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13. ON ONE METHOD OF SOLVING NEUMANN'S PROBLEM FOR THE LAPLACE EQUATION IN EVM (COMPUTERS) A. A. Stogniy p 138–142 refs

14. ON ONE METHOD ON SYNTHESIS OF ULTIMATE ABSTRACT AUTOMATION Yu. V. Kapitonova p 143–151 refs

15. SEVERAL GRAPHICAL METHODS OF CALCULATING NONLINEAR ELECTRICAL CIRCUITS V. M. Bondarenko p 152–164 refs

N64-32798 California U., Berkeley Electronics Research Lab.
DECISION MAKING IN INCOMPLETELY KNOWN STOCHASTIC SYSTEMS
J. Raviv 18 Jul. 1964 55 p refs
(NSF GP-2413; NSF G-15965)
(Rept.-64-25)

This paper is a study of decision making in a discrete-state discrete-time system whose state transitions constitute a Markov chain with unknown stationary transition matrix P. The states of the system cannot be observed. The decision at each stage is based on observables whose conditional probability distribution, given the state of the system, is known. A class of problems is considered in which the successive observations can be employed to form estimates of $\underline{P}$, with the estimates at time n, $n = 0, 1, 2, \ldots$, then used as a basis for making a decision at time n. The estimates and the corresponding decisions must have the property that as $n \to \infty$, the decision based on the estimate of $\underline{P}$ tends to the optimal decision rule that would be used throughout if $\underline{P}$ were known. Author

N64-32860 Cornell U., Ithaca, N.Y.
COGNITIVE SYSTEMS RESEARCH PROGRAM: COLLECTED TECHNICAL PAPERS, VOLUME 2
F. Rosenblatt ed. 30 Jul. 1963 201 p refs
(Contract Nonr-401(40); NSF GP-971)
(Rept.-4; AD-420696)

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N64-32863 Los Alamos Scientific Lab., N. Mex.
TABLES OF THE NUMBER OF BINARY DECOMPOSITIONS OF ALL EVEN NUMBERS $0 < 2n > 200\,000$ INTO PRIME NUMBERS AND LUCKY NUMBERS
M. L. Stein and P. R. Stein 24 Sep. 1964 442 p refs
(Contract W-7405-ENG-36)
(A-3106, Vol. I) OTS: $5.00

Tables are presented giving the number of decompositions of all even numbers $0 < 2n < 200\,000$ into two odd primes and two lucky numbers. Subsidiary tables are included that give certain statistical and enumerative data based on the primary tables. For the prime case (Goldbach decompositions) a probabilistic model is given by which the Goldbach curve can be fitted with satisfactory accuracy over the range considered. Author

N64-32866 Maryland U., College Park
QUASI-SEPARABLE SOLUTIONS OF SYSTEMS OF PARTIAL DIFFERENTIAL EQUATIONS. I: ELLIPTIC CASE Interim Technical Report
S. Levin and M. H. Martin 1 Sep. 1964 18 p
(Grant DA-ARO(D)-31-124-G563)
(AROD-407-66; AD-606801)

The study of uniqueness of solutions to boundary problems of partial differential equations has led to an overdetermined system of partial differential equations of the form

$$u_{x_1} = a_1 v_{x_1} + b_1 v_{y_1}, \qquad u_{x_1} = a_2 v_{x_2} + b_2 v_{y_2},$$
$$u_{y_1} = c_1 v_{x_1} + d_1 v_{y_1}, \qquad u_{y_2} = c_2 v_{x_2} + d_2 v_{y_2},$$

where a_1, b_1, c_1, d_1 are functions of x_1, y_1 and a_2, b_2, c_2, d_2 are functions of x_2, y_2. Among the results obtained are the following: Every solution is separable, i.e., may be written in the form

$$u = u_1(x_1,y_1) - u_2(x_2,y_2), \qquad v = v(x_1,y_1) - v_2(x_2,y_2),$$

unless the coefficient matrices of the two component systems share a constant eigenvalue. In the elliptic case this implies that the solution is always separable unless the system is reducible to the system of Cauchy–Riemann equations

$$u_{x_1} = v_{y_1}, \qquad u_{x_2} = v_{y_2},$$
$$u_{y_1} = v_{x_1}, \qquad u_{y_2} = v_{x_2},$$

for an analytic function $f = u + i\,v$ of two complex variables $z_1 = x_1 + i\,y_1$, $z_2 = x_2 + i\,y_2$. Author

N64-32949 Purdue U., Lafayette, Ind. Div. of Mathematical Sciences
ON A CHEBYSHEV-TYPE INEQUALITY FOR SUMS OF INDEPENDENT RANDOM VARIABLES
S. M. Samuels Sep. 1964 26 p refs *Its* Mimeograph Ser. no. 24

Let $S(\nu_1, \ldots, \nu_n)$ be the "class of all random variables", S_n, which are sums of n independent, nonnegative random variables, $X_1, \ldots, X_n$, with

$$E\,X_i = \nu_i, \quad i = 1, \ldots, n.$$

Considered is the problem of finding

$$\inf_{S_n \in S(\nu_1, \ldots, \nu_n)} P\{S_n < \lambda\}$$

where λ is a positive constant. Author

N64-32970 Stanford U., Calif.
GLOBAL PROPERTIES OF CLASSICAL MINIMAL SURFACES Technical Report No. 30
Robert Osserman 18 May 1964 19 p refs
(Contract DA-31-124-ARO(D)-170)
(AROD-13253-34; AD-446517)

This report examines the following questions: (1) Does there exist a complete simply-connected minimal surface, other than a plane, without self-intersections? (2) Can the normals to a complete minimal surface, other than a plane, omit more than two directions? (3) Do there exist complete minimal surfaces of infinite connectivity? (4) Do there exist complete minimal surfaces conformally equivalent to the unit disk? Answers to these questions, as well as several others, are presented. Author

N64-32993* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
USE OF THE FROBENIUS SERIES IN SOLVING HOMOGENEOUS LINEAR SYSTEMS OF DIFFERENTIAL EQUATIONS WITH WEAK SINGULAR POINTS
Russell E. Carr 27 Aug. 1962 11 p ref
(Contract NAS7-100)
(NASA-CR-58998; JPL-TR-32-322) OTS: $1.00 fs; $0.50 mf

Although the use of the Frobenius series in finding solutions of a homogeneous linear differential equation with weak singular points is well known, the extension of this method to systems of such equations is not ordinarily discussed in texts written in English. This report is written primarily for expository purposes. The method is first illustrated with an elementary

example, then applied to a specific problem that arose in connection with another study. The importance of obtaining the complete solution is discussed. Author

N64-33027 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON ONE EVALUATION OF DISTURBANCES OF SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS. I.
V. M. Alekseyev 18 Mar. 1964 13 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. i: Mat. i Mekhan. (Moscow), no. 2, 1961 p 28–36
(FTD-MT-63-312; AD-605602)

Solutions of the theory of ordinary differential equations and their association with the evaluation of disturbances are investigated. Changes in the right-hand sides of the considered systems and also of the initial conditions are examined. G. G.

N64-33087 Purdue U. Lafayette, Ind. Div. of Mathematical Sciences
ESTIMATION OF THE PARAMETERS OF THE LOGISTIC DISTRIBUTION
Shanti S. Gupta and Mrudulla N. Waknis Apr. 1964 31 p refs *Its* Mimeograph Ser. No. 15
(Contract AF 33(657)-11737)

The estimation by sample quantiles of the parameters μ and σ of the logistic distribution with mean μ and variance σ^2 is discussed. For large n and fixed number k of sample quantiles, it is shown that the symmetric optimum spacings of the quantiles estimating μ are $\lambda_i = i/k+1$ (i = 1,2, ... k). For the parameter σ, the equation giving optimum spacings do not give explicit solutions. In this case values of optimum spacings as well as coefficients of the best estimators are obtained numerically. Jung's and Blom's methods are used to approximate the best linear estimators. Estimators for the finite sample case based on midrange and range are also obtained. Tables of coefficients of various estimators, their variances and relative efficiency are given. Author

N64-33107 Cubic Corp., San Diego, Calif.
MATTS EVALUATION STUDY Final Report
T. B. Horne Eglin AFB, Fla., Res. and Technol. Div., Aug. 1964 396 p refs
(Contract AF 08(635)-3838)
(ATL-TDR-64-57, Vol. I, Pt 2; AD-449814)

This is the final report on the design, fabrication, and testing of a modified dual-hybrid antenna feed system of such a nature that the three signal sources could transmit simultaneously from one antenna. The following are discussed: "System Calibration Summary"; "PMR Calibrate Line Tests"; "Subroutines of G-15D Postflight Program"; "IBM Program Listings"; "Error Curves from IBM-7094 Data Reduction"; "Tables of Refractive Bending Errors"; "Revised Error Contours"; and "Error Propagation and Choice of Position-Determining Equations." G.G.

N64-33126 Army Materiel Command, Washington, D.C.
EXPERIMENTAL STATISTICS. SECTION I: BASIC STATISTICAL CONCEPTS AND STANDARD TECHNIQUES FOR ANALYSIS AND INTERPRETATION OF MEASUREMENT DATA
Mary G. Natrella (Natl. Bur. Standards) Jul. 1963 196 p refs
(AMCP-706-110)

Statistical procedures are presented with emphasis on their use in ordnance applications. The handbook is intended for the user with an engineering background but without thorough statistical training. R.L.K.

N64-33127 Army Materiel Command, Washington, D.C.
EXPERIMENTAL STATISTICS. SECTION 5: TABLES Engineering Design Handbook
Mary G. Natrella (National Bureau of Standards) Jul. 1963 98 p
(AMCP-706-114)

This is a collection of numerical tables and graphs for statistical applications, for use as a guide and ready reference in the preparation of tests and development programs for the Army Ordnance research. G.G.

N64-33146 Space Technology Labs., Inc., Redondo Beach, Calif.
ESPOD MATHEMATICAL AND SUBROUTINE DESCRIPTION
24 Jun. 1964 560 p refs
(Contract AF 19(628)-594)
(STL-8497-6065-RUOOO; ESD-TDR-64-395; AD-602783)
OTS: $8.00

An in-depth treatment of the mathematical and related computer processes used to develop the ESPOD program is presented. Included is the fundamental organization of the program, the background, and the general information relative to its options and the computer subroutines and coordinate systems. The entire ESPOD program is divided into three main segments: a data preprocessor, ESPOD; a differential corrector, ESPODDC; and an ephemeris generator, ESPODEPH. The preprocessor processes all the input data and acts as the main control package for the various program options available. It interprets the program control data input, the satellite observations input, and the other program modules. The function of the differential correction package is to determine the orbit that best fits, in the least-squares sense, the observational data and, as a result, to improve the initial values of the solution variables. The ephemeris predictor calculates the position and velocity of the satellite for a set of times specified in the preliminary data. P.V.E.

N64-33147 California U., Berkeley Lawrence Radiation Lab.
FORTRAN PROGRAM SUMX
Lynn Champomier 15 Apr. 1964 75 p
(Contract W-7405-ENG-48)
(UCRL-11222) OTS: $1.75

FORTRAN program SUMX is a data-summarizing program. SUMX constructs displays, in the form of lists, histograms, graphs, etc., from information extracted from sets of records on an input tape. Control cards specify the sets of records, the information to be extracted from each set, and finally, what sort of display is to be made from the information. Author

N64-33154* Martin Co., Baltimore, Md. RIAS Div.
THE NEIGHBORHOOD OF A SINGULAR POINT OF FUNCTIONAL DIFFERENTIAL EQUATIONS
J. K. Hale and C. Perelló Repr. from Contrib. Differential Equations, v. 3, no. 3 [1964] p 351–375
(Contracts NASw-845; AF 49(638)-1242; Nonr-3693(00))

An extension of the known results for ordinary differential equations to functional differential equations with finite time-lag is presented. The results are presented in the form of three theorems. The first theorem shows that if γ is a given real number ≥ 0 and if there are no eigenvalues with real part equal to γ, then, in a small neighborhood of the origin, the set of initial values at σ of solutions, which are $O(e^{\gamma(t-\sigma)})$ at $t \to \infty$, is homeomorphic and tangent at the origin to the hyperspace with the same property for the linear system. The second theorem

gives a similar result for $\gamma \geq 0$ and $t \leq \sigma$. Using these theorems, it is shown that if there be no purely imaginary eigenvalues, then there are local homeomorphisms and tangency at the origin between the sets of initial values at σ of solutions that tend to 0 as $t \rightarrow \infty$ or $t \rightarrow -\infty$ and the corresponding sets for the linear system. The third theorem states that a tubular neighborhood of the set of points that belong to solutions of the linear system tending to 0 as $t \rightarrow \infty$ can be removed, and simultaneously the solutions of the nonlinear system are crossing the boundary of this tube with increasing t and are going away in a sufficiently small neighborhood of the origin. P.V.E.

N64-33171* California U., Berkeley Electronics Research Lab.
A NONLINEAR RECURSIVE ESTIMATION PROCEDURE AND ITS APPLICATION TO CERTAIN NAVIGATION PROBLEMS
D. J. Sakrison 18 Aug. 1964 20 p refs
(Grant NsG-354)
(NASA-CR-58962; M-94) OTS: $1.00 fs; $0.50 mf

In the past 10 years, a class of recursive estimation methods, referred to as stochastic approximation methods, has been developed to handle problems where the observations without errors are nonlinear functions of the parameters to be estimated. Recently, such a method has been developed to yield asymptotically efficient estimates in the type of estimation problems encountered in radar and radio astronomy. The basic method used is also applicable to some of the estimation problems arising in space navigation. The purpose of this paper is to apply this method to navigation and carry out the required modifications in the analysis. This method has the following interesting features: (1) It is recursive and thus it allows real-time computation without extensive computing facilities; (2) It is applicable to a broad class of problems where the observables are nonlinear functions of the parameters to be estimated.
Author

N64-33200* Martin Co., Denver, Colo. Applied Mathematics Section
INVESTIGATION OF SUFFICIENCY CONDITIONS AND THE HAMILTON JACOBI APPROACH TO OPTIMAL CONTROL PROBLEMS Final Report
Henry G. Hermes Jul. 1964 72 p refs
(Contract NAS8-11020)
(NASA-CR-58775; Martin-CR-64-1(issue 7)) OTS: $3.00 fs; $0.75 mf

The use of Hamilton–Jacobi partial differential equations in determining fields of optimum trajectories is examined, and the sufficiency conditions are studied. The Kalman criterion for complete controllability for a linear system is derived in a simple manner, and an extension is obtained for a special form of nonlinear system. The nonlinear system $x(t) = g[t, x(t)] + H[t,x(t)]u(t)$, where x and n are vectors, H is an nxr matrix, and u and r are vector valued controls with $1 \leq r < n$, is studied. The local controllability in a neighborhood of singular arcs is considered. The study of feedback control via the Pontriagin maximum principle and Hamilton–Jacobi theory is discussed. Also discussed is the Hamilton–Jacobi theory for smooth approximate problems; for the special case of the control appearing linearly, and easy construction for a given approximating problem is shown. P.V.E.

N64-33222* Martin Co., Baltimore, Md. RIAS Div.
AN AUTOMATIC SYNTHESIS PROGRAM FOR OPTIMAL FILTERS AND CONTROL SYSTEMS, PROGRAM B Final Report
R. E. Kalman and T. S. Englar Jul. 1964 378 p
(Contract NAS2-1107)
(NASA-CR-58829) OTS: $7.00 fs; $2.00 mf

This report contains 11 chapters as follows: Chapter I, "The ASP Program"; Chapter II, "The Exponential Routines"; Chapter III, "The Transient Programs"; Chapter IV, "The Riccati Program"; Chapter V, "The Generalized Inverse Program"; Chapter VI, "The Sampled-Data Riccati Program"; Chapter VII, "The Decomposition Routine"; Chapter VIII, "The Inversion Program"; Chapter IX, "Manual of Techniques"; Chapter X, "Computation of a Canonical Realization"; Chapter XI, "Control System Design for an Earth Re-entry Vehicle."
E.C.

N64-33233 RAND Corp., Santa Monica, Calif.
OSCILLATORY AND UNIMODAL PROPERTIES OF SOLUTIONS OF SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS
Richard Bellman Aug. 1964 14 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4104-PR; AD-444518)

This article deals with a technique for studying properties of solutions to various types of differential equations. A Sturm oscillation theorem and the unimodal property of the solution $u'' + p(x)u = 0$ is demonstrated in analogous fashion, under the assumption that $p(x) > 0$.
G.G.

N64-33238 California U., Berkeley Lawrence Radiation Lab.
USE OF THE PROGRAM "EQUATION OF STATE 1964" (FORTRAN II)
Otto Redlich Sep. 1964 17 p refs
(Contract W-7405-ENG-48)
(UCRL-11645) OTS: $0.50

The program FORTRAN II is based on the Redlich and Kwong equation of state. This equation was improved by the addition of a deviation function for gases and of one for liquids. This program was used for the computation of the compressibility factor $Z = PV/RT$ and derived thermodynamic quantities for a pure substance or a mixture of up to seven compounds, with the critical temperature and pressure as required data, and Pitzer's acentric factor for each component. The program allows a variety of schedules of temperatures and pressures and output options, but it is not designed to handle negative pressures.
G.G.

N64-33249 Iowa State U. of Science and Tech., Ames Ames Lab.
MFOUR CRYSTALLOGRAPHIC FOURIER SUMMATION PROGRAM Research and Development Report
Mads Ledet May 1964 50 p ref
(Contract W-7405-ENG-82)
(IS-876) OTS: $1.25

This program was written as a substitute for MIFR1. There are four notable differences: (1) No symmetry manipulations are performed: (2) No sorting is made with regard to sine–cosine codes: (3) Summation is done completely in each direction before proceeding: (4) The program is for the IBM 7074 (20K).
Author

N64-33268 Geneva U. (Switzerland) Lab. de Statistique
COMBINATORIAL PROBLEMS IN DESIGN OF EXPERIMENTS
I. M. Chakravarti Wright-Patterson AFB, Ohio, ARL Jun. 1964 29 p refs
(Contract AF 61(052)-648)
(ARL-64-102; AD-607275)

The research is aimed at developing tools for construction of orthogonal arrays and mutually orthogonal Latin squares. A relationship is established between orthogonal mappings and difference sets for construction of orthogonal arrays. Permutation matrices are introduced to construct equimodular matrices with elements from the group of pth roots of unity. These matrices provide the difference sets. A brief review of important results is given. Some results in orthogonal arrays, which depend on the uniqueness of existence of association schemes, have been derived. Author

N64-33293 Columbia U., New York, N.Y.
OPTIMAL SELECTION BASED ON RELATIVE RANK (THE "SECRETARY PROBLEM")
Y. S. Chow (Purdue U.), S. Moriguti (Tokyo U.), H. Robbins, and S. M. Samuels (Purdue U.) 1 Sep. 1964 18 p ref
(Contracts Nonr-1100(26); Nonr-266(59); AF 33(657)-11737)
(CU-47-64-Nonr-266(59)MS; AD-606485)

The following optimal problem is considered. Let $x_1,\ldots,x_n$ denote a random permutation of the integers $1,\ldots,n$, all $n!$ permutations being equally likely. The integer 1 corresponds to the best (optimal) choice and n is the worst choice in order. For any $1=1,\ldots,n$ let $y_i = 1+$ number of terms $x_1,\ldots,x_{i-1}$, which are $< x_i$ (y_i = relative rank of the i^{th} integer to appear). For any stopping rule τ, the expected absolute rank of the integer selected is given by $EX = E(n+1/\tau+1\ y_\tau)$. To find the optimal τ by the method of backward induction, for $i = 0,1,\ldots,n-1$, it is necessary to define $c_i = c_i(n)$ = minimal possible expected rank of the integer selected. It is proven that the

$$\lim c_0 = \prod_{j=1}^{\infty}(j+2/j)^{1/j+1}.$$

P.V.E.

N64-33310 California U., Berkeley Operations Research Center
NONLINEAR PROGRAMS WITH POSITIVELY BOUNDED JACOBIANS
Richard W. Cottle 22 Jun. 1964 58 p refs
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-64-12(RR); AD-605549)

Properties and solution methods for inequality-constrained extremization problems are studied. Generally, the problems are considered as follows. Minimize $f_0(x)$ constrained by $f_i(x)\leq 0$, $1\leq i\leq m$, where the $f_i(0\leq i\leq m)$ are real-valued functions defined on real n-space. A symmetric formulation of duality for nonlinear programing is presented. Study of a dual pair of problems often leads to the consideration of a single system—the composite of the two; the composite problem is viewed as a special case of the general program—minimize $xW(z)$ constrained by $W(z)\geq 0$, $z\geq 0$ where W is a mapping of N-space into itself. Necessary and sufficient conditions are given for a solution of the general problem when W is a differentiable mapping with a suitably restricted Jacobian matrix. The concept of a positively bounded Jacobian matrix is presented in regard to the need for a sufficient condition to guarantee the existence of a solution to the general problem.

P.V.E.

N64-33311 California U., Berkeley Operations Research Center
PROGRAMMING UNDER UNCERTAINTY WITH DISCRETE D.F.
Mostafa El-Agizy 22 Jul. 1964 20 p refs
(Contract Nonr-222(83))
(ORC-64-13(RR); AD-605499)

Many realistic situations can be represented by the two-stage linear programing problem under uncertainty:

$$\min_{x} [cx + E \min_{b\ z} \gamma z],$$

$$a = Ax,$$

$$b = Bx + Dz, \text{ and}$$

$$x \geq 0, z \geq 0.$$

Where the matrices $A(m_1 \times n_1)$, B $(m_2 g B\ n_1)$, and $D(m_2 \times n_2)$ are known, a, c, γ are known vectors, and b is a random vector with known distribution. The case is discussed where demand has a discrete joint distribution with finite mean and D has the form (I, −I). No assumptions are made concerning the nonnegativity of the random vector b or of the vector $w = Bx$. The problem is reduced from an equivalent linear program to another linear program whose variables have upper bounds; and the number of equations and variables are reduced considerably by taking advantage of the optimality conditions. Two special cases that fit in this formulation are discussed: a transportation problem and a production-inventory problem. Author

N64-33312 California U., Berkeley Operations Research Center
LIMITING COVARIANCE IN MARKOV-RENEWAL PROCESSES
William S. Jewell 22 Jul. 1964 22 p refs
(Contract Nonr-222(83))
(ORC-64-16(RR); AD-605500)

General additive functions called rewards are defined on a "regular" finite-state Markov-renewal process. The asymptotic form of the mean total reward in [0,t] has previously been obtained, and it is known that the total rewards are joint-normally distributed as $t\rightarrow\infty$. This paper finds the dominant asymptotic term in the covariance of the total rewards as a simple function of the moments of the per-transition rewards the "bias" term of the mean total rewards. Special formulas for the dominant covariance term of "number of visits," and "occupation time" in given states are also derived. Author

N64-33337 Columbia U., New York, N.Y.
ON THE ASYMPTOTIC THEORY OF FIXED-WIDTH SEQUENTIAL CONFIDENCE INTERVALS FOR THE MEAN
Y. S. Chow (Purdue U.) and Herbert Robbins 9 Sep. 1964 16 p refs
(Contracts Nonr-1100(26); Nonr-266(59))
(CU-46-Nonr-266(59)MS; AD-606518)

Sequential equations are presented to find a confidence interval of prescribed width 2d and prescribed coverage probability $\underline{a}$ for the unknown mean μ of the population. Proofs of the elementary renewal theorem are reached through a modification of Doob's method. E.C.

N64-33374 Purdue U., Lafayette, Ind.
ON LINEAR FUNCTIONS OF ORDERED CORRELATED NORMAL RANDOM VARIABLES
Shanti S. Gupta and K. C. Sreedharan Pillai Mar. 1964 21 p *lts* Mimeograph Ser. No. 13
(Contract AF 33(657)-11737)

The characteristic functions of individual order statistics and the linear functions for the bivariate and trivariate cases for the general correlation matrix are studied. Formulas for the moments of $X_{(i)}$ are obtained. Series expansions for the distribution of the range and the midrange for this general case in the case are given. The joint distribution of the range and midrange is obtained in a closed form, and a gamma series expansion is also obtained for this distribution for the trivariate case.

From the form joint distribution of the latter series, the distribution of the ratio of mid-range to range can be obtained. The accuracy of the series expansions is discussed. D.E.W.

N64-33412 Space Technology Labs., Inc., Redondo Beach, Calif.
MATHEMATICAL MODELS FOR THE SYSTEM EFFECTIVENESS OF ROCKET BOOSTED PAYLOADS
A. J. Monroe 6 Jan. 1964 59 p refs
(STL-9990-6586-KU-000)

This memorandum describes the mathematical models and computational techniques used to predict the system effectiveness of rocket-boosted payloads as follows: (1) system description—subsystems and component parts; (2) mission description—tasks to be accomplished and initial conditions; (3) evaluation of mission success—criteria and standard tactical operating conditions; and (4) models—factors to be accounted for, figures of merit, data sources, and equations. The systems described are the Atlas E cryogenic ICBM, Atlas/Centaur Launch Vehicle, and OGO. Author

N64-33435 New York U., N.Y. AEC Computing and Applied Mathematics Center
THE STABILITY CRITERION OF GODUNOV AND RYABENKII FOR DIFFERENCE SCHEMES AEC Research and Development Report
Robert D. Richtmeyer 24 Aug. 1964 33 p refs
(NYO-1480-4)

This report discusses the numerical treatment of boundary conditions in finite difference calculations. The stability criterion introduced by Godunov and Ryabenkii as a guide to the effect of boundary calculations on stability is described, together with an application made to shock fitting in fluid dynamics. The criterion is in the spirit of the von Neumann condition in that it is concerned with local normal modes of the linearized difference equations; it is formalized in terms of the concept, defined by Godunov and Ryabenkii, of the spectrum of an infinite family of linear operators. Author

N64-33440 Oak Ridge National Lab., Tenn.
SOME ALGORITHMS FOR THE CALCULATION OF THE CHARACTERISTIC ROOTS AND VECTORS OF A NORMALIZABLE MATRIX
D. H. Clanton (Ph.D. Thesis, Auburn U.) Oct. 1964 57 p refs
(Contract W-7405-ENG-26)
(ONRL-3688) OTS: $1.50

This thesis presents, for a normalizable matrix A of order n, different algorithms for the development of a sequence of normalized vectors $q^{(j)}$ ($j = 0, 1, 2, \ldots$) such that the centers of their associated Weinstein disks are the Rayleigh quotients, $q^{(j)H} A\, q^{(j)}$. If the radii of the Weinstein disks approach zero as a limit, then the Rayleigh quotients associated with the sequence of vectors converge to a characteristic root of A.
Author

N64-33462 RAND Corp., Santa Monica, Calif.
IDENTIFICATION OF LINEAR SYSTEMS VIA NUMERICAL INVERSION OF LAPLACE TRANSFORMS
R. Bellman, H. Kagiwada, and R. Kalaba Aug. 1964 10 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4262-PR; AD-444517)

For a linear system either the weighting function or the coefficients of its N^{th} order linear equation is to be determined, based on observations of a process that the system undergoes. A method that uses our ability to invert Laplace transforms is proposed, and the results of a sample calculation are given.
Author

N64-33474 Bettis Atomic Power Lab., West Mifflin, Pa.
A FORTRAN COMPUTER PROGRAM FOR DATA REDUCTION OF PHOTOGRAPHS OF TWO-PHASE FLOW PHENOMENA
C. S. Rogers and E. R. Hosler May 1964 42 p ref
(Contract AT(11-1)-GEN-14)
(WAPD-TM-462) OTS: $1.00

This report describes a FORTRAN digital program that is used to reduce photographic or other types of growth and/or velocity data. From input consisting basically of X, Y, T coordinates for individual bubbles or other particles, the program will calculate the bubble diameter, volume and center location, vapor fraction of a specified volume, individual bubble velocities across channel, liquid velocity, and slip ratio. Author

N64-33481* National Aeronautics and Space Administration, Washington, D.C.
QUESTIONNAIRE LANGUAGE AND ABSTRACT SYNTHESIS OF MINIMAL SEQUENTIAL MACHINES [ANKETNYY YAZYK I ABSTRAKTNYY SINTEZ MINIMAL'NYKH POSLEDOVATEL'NOSTNYKH MASHIN]
A. A. Tal' Nov. 1964 34 p refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), v. 25, no. 6, 1964 p 946-962
(NASA-TT-F-260) OTS: $1.00

The author describes an algorithm for abstract synthesis of sequential machines. The algorithm differs from present algorithms in its application. It does not require preliminary formulation of the assignment in some language on the synthesized machine. The "designer" obtains all of the information about the properties of the machine to be synthesized from the "customer". This is done by executing an algorithm in the form of answers to questions of two types about sequences of situations that are external to the machine. The content of the questions at each stage is determined by the algorithm. Use of this algorithm leads to an unambiguous diagram of the states of the minimal sequential machine required by the "customer". Author

N64-33503 System Development Corp., Santa Monica, Calif.
FREQUENCY ANALYSIS OF MACHINE INSTRUCTIONS IN COMPUTER PROGRAM SYSTEMS
Robert E. Bleier 1 Oct. 1964 46 p
(Contract ARPA SD-97)
(TM-1603)

This paper reports partial results of an analysis to develop a tool for estimating the number of instructions in a program system. For the analysis, instructions were aggregated into classes, e.g., arithmetic, shift and decision. The analysis examined the relationships between the number of instructions in a class and the total number of instructions in a computer program system. The work completed to date provides counts of the number of instructions and classes of instructions in nine program systems. Results indicate that a consistent relationship exists between the number of instructions in the decision class and the length of each program system.
Author

N64-33508 Columbia U., New York, N.Y.
APPLICATION OF BALLOT THEOREMS IN THE THEORY OF QUEUES
Lajos Takács 17 Aug. 1964 106 p refs
(Contract Nonr-266(59))
(CU-45-64-Nonr-266(59)MS; AD-605130)

By using a discrete and a continuous generalization of the classical ballot theorem, the distribution of the supremum for partial sums of some interchangeable random variables taking

on integer values and the distribution of the supremum for some stochastic processes having interchangeable increments are found. The results obtained are applied to some single-server queues in order to find the stochastic law of the fluctuations of the queue size and that of the waiting time. Author

N64-33519 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE EQUIVALENCE OF CERTAIN HOMOLOGICAL DETERMINATIONS IN TOPOLOGY
M. F. Bokshtein 21 Sep. 1964 26 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mat. (Kazan), no. 3(16), 1960 p 62-80
(FTD-MT-63-348; AD-606555)

A direct proof is given of a theorem of the equivalence of internal groups of cohomologies of a local-bicompact Hausdorff space that are openly embedded in the bicompactum with relative groups of cohomologies of this bicompactum, using only the homological determinations of Aleksandrov. Also, the equivalence is proved of the determination of groups of cohomologies with the help of ordinary and multiplicative coverings, for both internal and related groups of cohomologies. This comprehensiveness makes it possible to use either of these determinations in the proof of the first theorem. D.E.W.

N64-33572 Johns Hopkins U., Baltimore, Md.
FUNCTIONAL COHOMOLOGY OPERATIONS AND RELATIONS Interim Technical Report
Jean-Pierre Meyer Aug. 1964 58 p
(Contract DA-31-124-ARO(D)-176)
(AROD-2799-6; AD-447303)

Relations in the Steenrod algebra are the basis for the existence of secondary cohomology operations. The similar connection between relations in the cohomology of a space Z and functional cohomology operations, while implicit in Steenrod's original paper, did not become equally clear, until the work of Mahowald, and Peterson–Stein on sphere-bundles. The relations discussed are of the form $\sum_{ij} z_{ij} \cup \theta_{ij} [z_j] = 0$, where z_{ij}, z_j are cohomology classes of Z, and θ_{ij} are (primary) cohomogy operations. The main purpose of this paper is to develop the theory of such functional cohomology operations. Author

N64-33591 Los Alamos Scientific Lab., N. Mex.
TABLES OF THE NUMBER OF BINARY DECOMPOSITIONS OF ALL EVEN NUMBERS $0 < 2n < 200\,000$ INTO PRIME NUMBERS AND LUCKY NUMBERS
M. L. Stein and P. R. Stein 29 Sep. 1964 426 p
(Contract W-7405-ENG-36)
(LA-3106, Vol. II) OTS: $5.00

This report contains the tables for the lucky number case analogous to those referring to the prime case given in the preceding volume. The differences between the prime case and the lucky case are the following: There are no "crossings" but one "contact" in the lucky Goldbach curve over the considered range; the cumulative average of the ratio $\lambda_{6m-2}/\lambda_{6m-2\pm2}$ appears to be approaching the "expected" value of 2; and the cumulative average of the ratio $\lambda_{6m}/\lambda_{6m+2}$ appears to be approaching unity. G.G.

N64-33621* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CAMEO. COMPUTER-INDEPENDENT ABSTRACT MACHINE-LANGUAGE ENCODER AND OPERATING-SYSTEM: SYSTEM DESCRIPTION
T. P. Gorman Jun. 1964 36 p refs
(NASA-TM-X-55074; X-542-64-148) OTS: $2.00 fs; 0.50 mf

This paper describes an Abstract Problem Oriented Machine (APOM) that restores to the program production both balance and simplicity. The programer is required only to master Program Language (PL), and Abstract Machine Language (AML). The steady-state process of program production using an APOM leads to very flexible responsiveness. Groups or teams can work in parallel or large problems with a consequent increase in productivity and reduction of lead time. G.G.

N64-33622* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CAMEO. COMPUTER-INDEPENDENT ABSTRACT MACHINE-LANGUAGE ENCODER AND OPERATING-SYSTEM: UNIVAC 1107 USAGE
S. A. Richmond, J. L. Maury, and P. H. Mc Clain 31 Aug. 1964 110 p
(NASA-TM-X-55096; X-542-64-248) OTS: $4.00 fs; $0.75 mf

This is a description of the new Cameo system of the Univac 1107 thin-film computer. It functions as an encoder for the Mystic abstract machine, with the only difference from the previous system occurring in the machine-language generation for the underlying computer. A complete Sleuth II program for encoding and its flow diagram are attached. G.G.

N64-33685* Case Inst. of Tech., Cleveland, Ohio
SOLUTION REPRESENTATIONS FOR LINEAR INITIAL VALUE PROBLEMS
William J. Davis Jul. 1964 37 p refs *Its* Rept.-200
(Grant NsG-544)
(NASA-CR-59322) OTS: $2.00 fs; $0.50 mf

This paper considers equations with classical solutions, corresponding to arbitrary polynomial initial-data functions in an expansion theory, for the solving of certain linear initial-value problems. A formal solution operator related to the equation, which transforms arbitrary polynomials in the space, variable into classical solutions of the equation, is used in the transformation of generalized Appell sets of polynomials into basic solution sets for the equation. The series expansions in terms of these solution sets are studied. G.G.

N64-33699* Massachusetts Inst. of Tech., Cambridge
SUPERPOSITION IN A CLASS OF NONLINEAR SYSTEMS
Alan V. Oppenheim Repr. from the IEEE Intern. Conv. Record, v. 12, pt. I, 1964 p 171–177
(Grants NsG-496; NIH MG-04737-03; NSF G-16526; Contract DA-36-039-AMC-03200(E))

This report presents a generalization of the principle of superposition and a discussion of the class of nonlinear systems that satisfy this generalized principle. In particular, this class is shown to include all invertible systems. A canonical representation for systems in this class is derived, which consists of a cascade of three systems, the first and last of which are dependent upon a general property of the system inputs and outputs, respectively. The second system in the canonical representation is a linear system. Necessary and sufficient conditions are presented under which all of the memory in the system can be concentrated in the linear portion. Applications of the theory are considered for a class of nonlinear feedback systems. IAA

N64-33720 Aeronutronic, Newport Beach, Calif.
GENERAL EPHEMERIS ROUTINE FORMULATION DOCUMENT

Jeannine L. Arsenault, Lois Chaffee, and James R. Kuhlman
Bedford, Mass., AFCRL, Electron. Systems Div., Aug. 1964
64 p refs
(Contract AF 19(628)-3393)
(U-2731; ESD-TDR-64-522; AD-445852)

This report presents formulation, which was coded for the Philco 2000 digital computer, for computation of ephemerides of artificial earth satellites. The program is designed to operate in the SPADAT system as a utility routine. It describes satellite motion in orbits for all inclinations and with eccentricities from 0 to 0.99. Three general perturbations techniques are set forth: one is a complete first-order theory of the perturbations caused by the asphericity of the earth in terms of the second, third, and fourth zonal harmonics of the geopotential; two are simplified versions. Empirical representation of the effects of the earth's atmosphere and analytical development of direct solar radiation pressure perturbations are common to the three methods. The program also interpolates ephemerides of inertial coordinates of position and velocity or of orbital elements generated by special perturbations techniques. Author

N64-33786 Stanford Research Inst., Menlo Park, Calif.
COUPLED MODE THEORY FOR ADVANCED MICROWAVE DEVICES
M. C. Pease and C. W. Barnes Oct. 1963 43 p refs
(Contract AF 33(657)-8343)
(IR-6; AD-421753)

The development and application of a generalized theory of the coupling of the modes of propagation, such as occur in distributed microwave devices are discussed. The concepts and principal theorems of Lie algebra are reviewed, and the pertinent parts of the theory are put into a form that is applicable to coupled-mode problems. Coupled-mode problems are classified according to whether the covering algebra is semisimple or not. Analysis of the statistical effect of random coupling in uniform systems is discussed. P.V.E.

N64-33788 Purdue U., Lafayette, Ind.
A HANDBOOK OF STATISTICAL CLASSIFICATION TECHNIQUES
Carl F. Kossack 1964 138 p refs
(AD-601886) OTS: $2.75

Subjects covered include a brief history of classification theory; the general characteristics of classification techniques; an illustrative example and several aspects of classification techniques, including nonparametric, categorical, and general-parametric classification techniques; and the Wald, Purdue, Anderson, and Shaw classification statistics. The multipopulation problem is treated briefly, and an extensive bibliography is presented. D.E.W.

N64-33802* Case Inst. of Tech., Cleveland, Ohio
THE RADIAL HEAT POLYNOMIALS AND RELATED FUNCTIONS
Louis R. Bragg Sep. 1964 30 p refs *Its* Rept.-203
(Grant NsG-544)
(NASA-CR-59339) OTS: $2.00 fs; $0.50 mf

This is a detailed study of necessary and sufficient conditions for the validity of expansions of solutions for a generalized heat equation. The operator used is the Laplacian in radial coordinates with a positive integer. The results, taking into account the expansions of solutions, are gained in terms of the two basic sets of functions related to the radial heat polynomials and their Apell transform. These sets are defined in terms of the generalized Laguerre polynomials. Differences arising from the use of Laguerre polynomials assert themselves in the bounds on the basic sets of functions, the kernel of the integral representation of the solutions, and the decomposition of this kernel. G.G.

N64-33952 Aerospace Research Labs., Wright-Patterson AFB, Ohio Applied Mathematics Research Lab.
MORE TABLES OF THE INCOMPLETE GAMMA-FUNCTION RATIO AND OF PERCENTAGE POINTS OF THE CHI-SQUARE DISTRIBUTION
H. Leon Harter Aug. 1964 98 p refs
(ARL-64-123; AD-439763) OTS: $2.25

The following tables, together with brief discussions of methods of computation and uses, are included: (1) a nine-decimal-place table of the incomplete gamma-function ratio, I(u,p), for p = −0.95(0.05)4 and u at intervals of 0.1; and (2) a six-significant-figure table of the percentage points, corresponding to cumulative probabilities P = 0.0001, 0.0005, 0.001, 0.005, 0.01, 0.025, 0.05, 0.1, (0.1)0.9, 0.95, 0.975, 0.99, 0.995, 0.999, 0.9995, and 0.9999, of the chi-square distribution with ν = 0.1(0.1)10 degrees of freedom. Both tables are accurate to within a unit in the last place. Author

N64-33953 Aerospace Research Labs., Wright-Patterson AFB, Ohio Applied Mathematics Research Lab.
MULTIPLE COMPARISON TESTS IN MULTIVARIATE CASE
P. R. Krishnaiah Aug. 1964 34 p refs
(ARL-64-124; AD-430623) OTS: $1.00

Various test procedures are considered for the multiple comparisons of mean vectors when the parent populations are assumed to be multivariate normal with a known or unknown covariance matrix. The relative merits of these procedures are also investigated. Author

N64-33986 Pacific Missile Range, Point Mugu, Calif. Operations Research Group
A MATHEMATICAL FORMULATION AND SOLUTION OF A MULTIPLE-RESOURCE SCHEDULING PROBLEM
R. V. Skarda, Jr. 1 May 1963 22 p refs
(PMR-TM-63-6; AD-403342)

An algorithm is proposed for determining optimal ways of scheduling multiple operations, each of which must be serviced by a number of resources simultaneously. The objective is to allocate the resources on a time-scale such that all the desired operations may be completed in the minimum time possible. By means of a selective searching procedure, the algorithm in effect considers all possible allocations but in much less time than direct enumeration would entail. The result is an optimal schedule or time sequence for operations. The basic inputs to the algorithm are each operation's time requirements on each type of resource and a statement of the resources that the servicing system has available for allocation. The procedure is deterministic in the sense that the operational time requirements, which are in truth probabilistic, are assumed to be known exactly. Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-32783 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON METEOROLOGY AND HYDROLOGY
7 Oct. 1964 62 p refs Transl. into ENGLISH of 11 articles from Meteorol. i Gidrol. (Moscow), no. 8, Aug. 1964
(JPRS-26772; TT-64-51029) OTS: $3.00

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7. SIXTIETH BIRTHDAY OF VLADIMIR GEORGIYEVICH SHISHKOV NOTED A. L. Kats p 40–42
8. FIFTIETH ANNIVERSARY OF THE HYDROCHEMICAL INSTITUTE V. N. Zakharov p 43–44
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N64-32784 Joint Publications Research Service, Washington, D.C.
CYCLONE OVER THE CASPIAN SEA PHOTOGRAPHED FROM AN ARTIFICIAL SATELLITE
V. A. Dzhordzhio and O. A. Lyapina *In its* Transl. on Meteorol. and Hydrol. 7 Oct. 1964 p 1–5 ref (See N64-32783 24-21) OTS: $3.00

A comparison is made of the information that could be obtained from a photograph of a cyclone over the Caspian Sea (taken from Tiros VII) and information taken from operational charts having synoptic data for the same area. It is concluded that the use of satellite pictures is far superior to the use of synoptic charts in determining the weather for an area; and that the satellite gave a more detailed pattern of a cyclonic cloud system over the central part of the sea than did tens of synoptic stations on shore. P.V.E.

N64-32785 Joint Publications Research Service, Washington, D.C.
DETERMINATION OF THE THERMODYNAMIC STABILITY OF THE ATMOSPHERIC BOUNDARY LAYER FROM BALLOON OBSERVATIONS
A. I. Buz *In its* Transl. on Meteorol. and Hydrol. 7 Oct. 1964 p 6–15 refs (See N64-32783 24-21) OTS: $3.00

On the basis of temperature sounding data obtained at Kaunas during the summer months of 1957 to 1959, it was found that in the presence of a temperature inversion in the boundary layer, regardless of its origin, there was a relative wind-velocity maximum near the upper boundary of the inversion. Direct comparison of the curvature of the temperature and wind-velocity profiles (without direction being considered) in the lower kilometer layer of the atmosphere revealed a fair relationship between the values. The extent to which wind-velocity profile determines the temperature stratification of the atmosphere is discussed along with the way in which changes in the wind profile in time can be related to changes of the turbulence coefficient. P.V.E.

N64-32787 Naval Research Lab., Washington, D.C.
SOME METHODS FOR WORLD-WIDE ATMOSPHERIC RADIO DUCT MEASUREMENT AND PREDICTION
D. L. Randall *In its* Rept. of NRL Progress Jun. 1964 p 3–16 refs (See N64-32786 24-10) OTS: $1.25

Vorticity fields showing areas of divergence or convergence in the air-mass flow channels at or above the gradient wind level may be located on a weather map and are theoretically related to the formation of dissipation of elevated radio ducts at vhf and uhf. Theoretical predictions of elevated radio duct formation have been verified by measurements made on a trip around the world, February 8 to March 15, 1962, in an aircraft. On the basis of this theory and the meteorological measurements, oceanic regions in the world most likely to support radio duct formation at different seasons of the year are indicated. Author

N64-32791 Commonwealth Scientific and Industrial Research Organization, Sydney (Australia) Radiophysics Lab.
CLOUD SEEDING EXPERIMENT, WARRAGAMBA, 1962 Annual Report
E. J. Smith, E. E. Adderley, and F. D. Bethwaite May 1963 113 p

A long-term experiment is in progress in which clouds are seeded with silver-iodide smoke released from an aircraft, with random choice of two areas. In the third year's operation, the rainfall figures are in the opposite sense to that expected if seeding were successful. The combined figures for the three years show a very small increase. They are consistent with seeding causing an increase in rainfall with cumulus clouds and a reduction with stratiform clouds. Author

N64-32805 New York U., N.Y. Courant Inst. of Mathematical Sciences
NUMERICAL STUDIES OF FRONTAL MOTION IN THE ATMOSPHERE—I
A. Kasahara, E. Isaacson, and J. J. Stoker Sep. 1964 60 p refs
(Contracts Nonr-285(55); AT(30-1)-1480)
(NYO-1480-6; TID-4500(32nd ed.))

The motion of frontal disturbances in the atmosphere is studied by the numerical solution of differential equations based upon a two-layer model of an incompressible fluid on a rotating earth. The density of each layer is assumed to be constant. The upper and lower fluids correspond respectively to warm and cold air. In this first attempt, only the motion of the lower cold air layer is studied by assuming, in effect, that the dynamics of the perturbations in the upper warm air layer can be neglected. The numerical study of this simple mechanical model shows that even though thermodynamic processes have been ignored, the occlusion process, characteristic for warm and cold fronts, develops from an initially sinusoidal frontal pattern. Author

N64-32807 Joint Publications Research Service, Washington, D.C.
MILITARY SIGNIFICANCE OF WEATHER CONTROL

M. V. Belyakov 12 Oct. 1964 26 p Transl. into ENGLISH from the book "Vozdushnyy Okean" Voyennoye Izd. Min. Oborony SSSR, Moscow, 1963 p 106–130
(JPRS-26861; TT-64-51118) OTS: $1.00

This article considers natural and artificially produced weather elements and their application in war. Possible effects on men, airplanes, rockets, or the enemy soil are observed. G.G.

N64-32815 Aracon Geophysics Co., Concord, Mass.
FLEET APPLICATIONS—METEOROLOGICAL OPERATIONAL SATELLITES (TROPICS—EASTERLY WAVES) Final Report
Earl S. Merritt Dec. 1963 53 p refs
(Contract N189(188)-56897-A)
(ARA-F-9252-2; AD-449768)

Analyses of tropical perturbations in the Atlantic region (commonly referred to as easterly waves), utilizing observations from meteorological satellites, reveal that five distinctly different cloud distributions occur. These patterns are both linear (similar to the classic Riehl model of the easterly wave) and vortical. The vortical patterns appear most frequently and are often related to a closed cyclonic circulation in the midtroposphere. Calculations of the horizontal and vertical distribution of divergence and vorticity, which are indicative of a midtroposphere circulation in an intense disturbance, are shown. Author

N64-32872 Army Chemical Center, Edgewood, Md.
A COMPILATION OF CAMP CENTURY ENVIRONMENTAL MONITORING DATA FROM 28 JUNE 1962–9 OCTOBER 1963
George D. Oliver, Jr., Uldis I. Ievans, David T. Kilminster, and John H. Mc Neilly Jun. 1964 36 p
(NDL-TR-63; AD-448296)

Alpha and beta activities of weekly water and melted snow samples are reported in microcuries per milliliter. Similar measurements of daily air samples are reported in microcuries per cubic centimeter of air. Gamma survey readings of the sampling stations are also included. All observed sample activities were below the maximum permissible concentrations. Author

N64-32881 National Aeronautical Lab., Bangalore (India)
A STUDY OF THE HOURLY WIND SPEEDS AT CALCUTTA (DUM DUM) FROM THE POINT OF VIEW OF WIND POWER UTILISATION
M. S. Prakasa Rao and S. R. Radhakrishnan Jun. 1963 19 p ref
(TN-WP-28-63)

The hourly wind speed data of Calcutta (Dum Dum) for the years 1958 to 1960 have been analyzed. The frequency distribution and the cumulative frequencies of the hourly wind speeds were computed and used to work out the energy extractable from wind. The number of hours of low wind, the spells of such low winds, and the diurnal variation are discussed. The annual mean wind speed works out to 9 km/hr. The annual energy output of a wind electric generator with 30 m^2 swept area, and 12% overall power coefficient is 1009 kWh. The water pumping capacity of a WP-2 type windmill is 30 500 kl (6 710 000 gal) per annum or 18 400 gal per day. Author

N64-32935 Commerce Dept., Washington, D.C.
ON THE MOTION AND PREDICTABILITY OF CONVECTIVE SYSTEMS AS RELATED TO THE UPPER WINDS IN A CASE OF SMALL TURNING OF WIND WITH HEIGHT
James C. Fankhauser Jan. 1964 40 p refs
(Rept.-21)

Radar composites of the extensive squall-line development of May 28, 1962, as well as the individual convective storms comprising the line, are compared to the mean wind in the troposphere. The case is distinctive since, contrary to the situation most common to vigorous convective outbreaks, there is only small turning of wind with height. The component contributions of translation and propagation toward echo motion are proposed to be linked to the mean and shear winds. Their influences on the motion of individual elements as well as on the aggregate line are discussed, and the relationship between movements of individual storms and the squall line as a whole are summarized. Squall-line displacement and orientation are found to have a high degree of correlation with mean wind direction. Author

N64-33015 Commonwealth Scientific and Industrial Research Organization, Sydney (Australia) Radiophysics Lab.
INVESTIGATIONS OF ATMOSPHERIC ICE NUCLEI Interim Report, Sep. 1962–Aug. 1963
S. C. Mossop, K. J. Heffernan, and N. S. C. Thorndike Sep. 1963 17 p
(RPR-149)

This article pertains to the origin of airborne dust particles, also known as "ice nuclei." The ground measurements of ice-nuclei concentration showed their association with the position of jet streams. The high concentration of ice nuclei found in the stratosphere are interpreted as strong evidence that these particles are not of ground origin. Samples of the particles, collected with a millipore filter installed in aircraft, underwent electron microscopic examination. It was found that ice nuclei consisted mainly of soluble ammonium sulphate, and that their insoluble parts are of extraterrestrial dust. G.G.

N64-33062 Navy Weather Research Facility, Norfolk, Va.
A CLIMATOLOGY OF WIND AND TEMPERATURES IN THE TROPICAL STRATOSPHERE BETWEEN 100 MB. AND 10 MB.
Richard J. Reed et al May 1964 59 p
(NWRF-26-0564-092; AD-444324)

Data (1951–1961) from selected tropical stations are used to characterize the annual and 26-month variations in the zone between 25° N and 25° S and in the layer between 100 mb and 10 mb. Information is also presented on the long-term (10 year) mean zonal wind and the temperature fields and on the short-period (intramonthly) variability of the zonal and meridional wind components. Author

N64-33091 Freie U., Berlin (W. Germany) Inst. für Meteorologie und Geophysik
DAILY AND MONTHLY NORTHERN HEMISPHERE 30-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1963. PART II: APRIL–JUNE
Barbara Kriester, Karin Labitzke, Drazen Poje, Richard Scherhag, and Renate Stuhrmann Berlin, Dietrich Reimer, 1963 106 p ref *Its* Meteorol. Abhandl., v. 39, no. 2
(Contract DA-91-591-EUC-2857)
(QTSR-2; AD-443554) Available from D. Reimer Verlag, Berlin, 40 Drakestrasse: 15 DM

Compared to 1962 the 30-mb contour values in June 1963 were higher over the whole Northern Hemisphere. The difference was much greater over continental areas than over

the Atlantic and Pacific oceans and was greatest over the interior of Asia. This is clearly proved by the Berlin radiosonde ascents, which show remarkably higher temperature and contour values in June 1963 than in June 1962. Also, the upper stratospheric winds blew more from the southeast in the warm summer of 1963 than in the cool summer of 1962. Author

N64-33092* California U., Berkeley
HURRICANE MODIFICATIONS: PROGRESS AND PROSPECTS 1964
R. H. Simpson (Weather Bureau) and Joanne S. Malkus Aug. 1964 77 p refs
(Grant NsG-481; Contract Nonr-4071)
(NASA-CR-59080) OTS: $3.00 fs; $0.75 mf

Necessary restrictions applying to experiments that are designed to modify clouds and hurricanes are discussed. Early experimental attempts at hurricane modification are reviewed, the role of clouds and the structure and functioning of a hurricane are described; the physical basis of the series of experiments in Stormfury Project is discussed; the experiment on Hurricane Beulah in 1963 is described in detail and results are presented; and the problem of reproducibility is stated. Individual cloud experiments and their implications for hurricane modification are described, as are other potential approaches to hurricane modification. D.E.W.

N64-33105 Air Weather Service, Scott AFB, Ill.
FORECASTERS' GUIDE ON AIRCRAFT ICING
15 Sep. 1964 54 p refs Supersedes AWSM-105-39, 1 Oct. 1960
(AWSM-105-39; AD-448704)

This manual provides information on aircraft icing for use in forecasting and briefing for Air Force operations. A procedural outline is suggested taking into consideration the significant physical and operational factors, the distribution of icing in the atmosphere, and nonsynoptic forecast aids. Physical factors affecting icing are temperature, liquid-water content of clouds, droplet size, and the collection efficiency of the aircraft component involved. The operational aspects of icing are discussed in relation to reciprocating-engine, turbojet, turbopropeller, and rotary-wing aircraft. The atmospheric distribution of potential aircraft-icing zones varies with altitude, synoptic situation, orography, location, and season. R.L.K.

N64-33246 Freie U., Berlin (W. Germany) Inst. für Meteorologie und Geophysik
DAILY AND MONTHLY NORTHERN HEMISPHERE 30-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1964. PART I: JANUARY–MARCH Quarterly Technical Status Report
Barbara Kriester, Richard Scherhag, and Renate Stuhrmann Berlin, Dietrich Reimer, 1964 105 p *Its* Meteorol. Abhandl., V. 48, No. 1 Dietrich Reimer: 15 DM
(Contract DA-91-591-EUC-2857)
(QTSR-1; AD-444947)

This is a collection of daily and monthly weather maps for January to March 1964, from the Northern Hemisphere. Monthly mean data for isohypses, isotherms, and vector winds are also presented. G.G.

N64-33260 Institut Royal Meteorologique de Belgique, Brussels
THE PROBLEM OF THE SCALE HEIGHTS AND THEIR GRADIENTS IN THE HETEROSPHERE [LE PROBLEME DES HAUTEURS D'ECHELLE ET DE LEURS GRADIENTS DANS L'HETEROSPHERE]
G. Kockarts 1964 27 p refs In FRENCH; ENGLISH summary *Its* Contrib. No. 91 Repr. from Bull. Acad. Roy. Belg., 14 Dec. 1963 p 1281–1304

The properties of the heteorosphere are discussed in terms of the behavior of scale heights and their gradients. The height variation of the mean molecular mass leads to important gradients of scale heights in the isothermal region of the heterosphere. An analysis of the atmospheric scale height H and the density scale height H_ρ, which increase with altitude, shows that $H \geq H_\rho$ everywhere. Their positive gradients β and β_ρ may have all possible values between 0 and 1.5. The gradient β_ρ is not less than β in the thermosphere, but may be greater or less than β in the isothermal region, depending on the thermopause temperature. Author

N64-33301 Deutscher Wetterdienst, Offenbach am Main (W. Germany)
CONTRIBUTIONS TO THE KNOWLEDGE OF THE STRUCTURE OF THE ATMOSPHERE BENEATH 70 KM Final Report
Heinrich Faust, W. Attmannspacher, E. Soos, and E. Toth Apr. 1964 47 p refs
(Contract DA-91-591-EUC-2847-OI-360529-3)
(AD-444803)

This report concerns new evaluations of rocket measurements and a detailed discussion of aerological conditions in the stratosphere and mesosphere. Year isopleths of the mean zonal wind components in latitudes 20°, 30°, 40°, and 60° N are presented. Wind profiles indicate a division of the atmosphere below 80 km into two dynamic systems, the separation layer of which is at a height of about 20 km. The energy-providing heating level for the lower system is the surface; that for the system at about 20 km is the upper boundary of the ozone layer. Mean wind profiles for spring, fall, and winter are discussed. A persistent wind extreme layer is combined with a reversion of the horizontal gradient of the temperature. Sunspot extremes do not coincide with extremes of yearly mean-temperature curves. Because of the photochemical processes at the O_3 molecule, the temperature changes resulting from uv absorption may by no means be regarded as strictly proportional to the radiation quantity. E.C.

N64-33315 General Mills, Inc., Minneapolis, Minn. Electronics Div.
TROPICAL UPPER AIR STUDIES. PART I: PERSISTENCE OF THE DAILY STRATOSPHERE WINDS IN THE TROPICS. PART II: LONG-PERIOD WIND FLUCTUATIONS IN THE TROPICS Final Report, 30 Mar. 1962–30 Mar. 1964
A. D. Belmont, W. C. Shen, and D. G. Dartt 1 Apr. 1964 105 p refs
(Contract DA-36-039-SC-89211)
(GMI-2562; AD-602851)

The 50-mb daily winds at Canton Island, Balboa, and San Juan were examined for persistence of wind direction, scalar speed, and zonal speed. Means and standard deviations of scalar and zonal winds were also compared. A new method has been suggested and applied to the computation of persistence of wind direction. Results indicate that persistence in wind direction is greater than persistence in zonal wind speed, which in turn is greater than persistence in scalar wind speed. Persistence of all three of these parameters was noticed to depend on wind regime, length of period, and mean wind speed. Persistence of easterlies was far greater than that for westerlies for all three stations: it usually increased as the time series increased, and it generally decreased with increasing wind speed. Author

N64-33354 Illinois State Water Survey, Urbana Meteorologic Lab.
INVESTIGATION OF THE QUANTITATIVE DETERMINATION OF POINT AND AREAL PRECIPITATION BY RADAR ECHO MEASUREMENTS Quarterly Technical Report, 1 Jan.–31 Mar. 1963
E. A. Mueller [1963] 20 p refs
(Contract DA-36-039-SC-87280)
(QTR-6; AD-406843)

Processing of raindrop camera data has been continued in a routine manner. The preliminary computations on the raindrop data are up to date. Stratifying the data with respect to the condensation level, determined by the radiosonde, was completed. The results indicate that there is a significant difference in the drop size distributions from the high condensation levels as compared to the low condensation levels for low precipitation rates. At moderate to strong rainfall rates, the difference in the distributions becomes considerably less apparent. Author

N64-33404 Weather Bureau, Las Vegas, Nev.
WEATHER AND SURFACE RADIATION PREDICTION, FALLON, NEVADA, OCTOBER 26, 1963. VELA UNIFORM Final Report
A. N. Hull, R. W. Titus, and H. F. Mueller 30 Oct. 1964 40 p
Sponsored by ARPA and AEC
(Project SHOAL)
(VUF-1008) OTS: $2.00

The Weather and Surface Radiation Prediction Unit commenced preliminary weather observations at the SHOAL Site in August 1962. Sufficient data were collected to insure statistical significance. A complete weather analysis and forecasting unit was in operation at the SHOAL Site. The weather facilities, observation schedules, detailed preshot weather and radiation forecasts, and their verification are discussed. Author

N64-33419 Travelers Research Center, Inc., Hartford, Conn.
COMBINATION OF INITIAL AND PROGNOSTIC DATA IN STATISTICAL CLOUD PREDICTION
Duane S. Cooley, Frederick P. Ostby, Donald A. Chisholm, and Abraham M. Pavlowitz Bedford, Mass., AFCRL, Electron. Systems Div., Mar. 1964 60 p refs
(Contract AF 19(628)-3357)
(ESD-TDR-64-62; AD-434072)

A study has been made of the statistical prediction of low- and total-cloud amounts from parameters derived from numerical weather prediction (NWP). Air Weather Service moisture and temperature analyses and predictions, and other meteorological variables. Cloud data and other atmospheric data over Eurasia and the Arctic were analyzed on a grid mesh of approximately 208 mi (the NWP grid). Predictability of cloud amount was evaluated by using screening regression and multiple-discriminant analysis and testing the predictions on independent data. Predictors considered included cloud amount, 1000-, 850-, and 500-mb height, geostrophic-wind components, surface and upper-level temperatures, stability, vorticity, divergence, upslope motion, thickness of isobaric layers, condensation-pressure spread, and vertical velocity. Author

N64-33425 Aberdeen Proving Ground, Md. Ballistic Research Labs.
ATMOSPHERIC TRANSMISSION OF LIGHT FOR CLEAR AIR AND FOG IN THE SPECTRAL REGION 0.35 TO 1.10 MICRONS
Alan R. Downs Apr. 1964 41 p refs
(BRL-MEMO-1561; AD-444333)

Methods are described for estimating the transmission of light by a clear atmosphere for humidities ranging from 0.1 $\times 10^{-6}$ to 100 $\times 10^{-6}$g/cm^3 and temperatures between $-40°$C and $+60°$ C for path lengths between 1000 and 5000 m. Also transmissions are given for varying amounts of fog for path lengths up to 200 m. The paths used are horizontal, and near sea level and wavelength intervals of 0.05μ are used between wavelengths of 0.35μ and 1.10μ. Author

N64-33469 Los Alamos Scientific Lab., N. Mex.
STRONTIUM-90, CESIUM-137, AND RADIOACTIVE RARE EARTHS IN ENVIRONMENTAL RAIN AND AIR AT LOS ALAMOS, NEW MEXICO, 1958–JUNE 1963
E. R. Graham 1 Oct. 1964 19 p refs
(Contract W-7405-ENG-36)
(LAMS-2878) OTS: $0.50

The activity of the strontium-90 was highest during the summer of 1958; then it decreased slowly, reaching the lowest level during September of 1961. Starting in October of 1961 the activity started to rise, but it never reached the level of 1958. The observed results of the environmental concentration of cesium-137 and rare-earth radioactivity were similar to those for strontium-90. The results of the activity measured in air and rain followed the same monthly distribution. Author

N64-33517 France Direction de la Meteorologie Nationale, Paris
THE CYCLONES OF THE SOUTHWESTERN INDIAN OCEAN [LES CYCLONES DU SUD-OUEST DE L'OCEAN INDIEN]
Albert Chaussard and Laurent Laplace 1964 150 p refs
In FRENCH *Its* Mem. 49

A working hypothesis is formulated according to which a tropical cyclone occurs as the result of an equilibrium between the convergent flux of low layers and the divergent flux of high layers. A vertical ascending flux is required to form a connection between these two horizontal fluxes, and the pressure field evolved by the total action of these three fluxes creates the field of force necessary for a cyclone to develop. The introduction of Coriolis accelerations in the calculations permits the definition of an accessible zone of moving air with both internal and external bounds, and also permits the qualitative determination of the essential synoptic properties of these storms. Thus, the vertical movement is not a consequence of horizontal movement but rather the prime cause of it. This working hypothesis was developed from a study of cyclone data for the southwestern Indian Ocean from Nov. 1911 to April 1961. These data are presented and discussed. M.P.G.

N64-33569* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A REFERENCE ATMOSPHERE FOR PATRICK AFB, FLORIDA, ANNUAL (1963 REVISION)
O. E. Smith and Don K. Weidner 23 Sep. 1964 50 p refs
(NASA-TM-X-53139) OTS: $2.00 fs; $0.50 mf

The reference atmosphere established by this study is based on the most current annual statistical parameters of pressure–height, temperature, and relative humidity for the constant pressure levels from 0- to 28-km altitude and on a defined temperature-versus-altitude relationship from 28- to 90-km altitude. It is also extended to 700-km altitude. The technique was refined by simplification of the expression for geopotential height. Computed values of pressure, kinetic temperature, virtual temperature, molecular temperature, density, coefficient of viscosity, kinematic viscosity, speed

of sound, molecular weight, pressure ratio, density ratio, viscosity ratio, and pressure difference are tabulated from 0- to 700-km altitude. Author

N64-33584 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
PROGRESS IN ATMOSPHERIC PHYSICS: A SUMMARY OF HANFORD LABORATORIES WORK ON THIS PROGRAM UNDER GENERAL ELECTRIC, 1959–1964
J. J. Fuquay, comp. Sep. 1964 51 p refs
(Contract AT(45-1)-1350)
(HW-83602) OTS: $2.00

The meteorological research facility is described, and advances in atmospheric tracer technology are outlined, with emphasis on the Rankin counter system, the Tri-Carb system, and the real-time sampler. Precipitation scavenging research is discussed, scavenging efficiencies of different sizes of raindrops are graphed, and washout coefficients for very light rains are tabulated. Atmospheric dispersion experiments are summarized, and significant results are explained. D.E.W.

N64-33653 Freie U., Berlin (W. Germany) Inst. für Meteorologie und Geophysik
EXAMINATION OF 24 HOUR SURFACE CHARTS Final Technical Report, 1 Aug. 1962–31 Jul. 1963
[1963] 29 p refs
(Contract DA-91-591-EUC-2409)
(AD-420654)

This report describes the major features of the proposed design that provides for measurement of cosmic radio noise below 10 Mc/sec with a directive antenna. In the first section the scientific objectives of the satellite experiment are summarized. The second and third sections are devoted to discussion of the antenna concepts and electronics, respectively. The salient features of the proposed radioastronomy satellite are summarized in the final section. Author

N64-33693* Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.82 GG, 11 AUGUST 1964 Meteorological Data Report
Marjorie Mc Lardie Hoidale Aug. 1964 43 p refs
(NASA-CR-59269; ERDA-182) OTS: $2.00 fs; $0.50 mf

Meteorological data gathered for the launching of Aerobee NASA 4.82 GG are presented, along with calculated ballistic data. Author

N64-33707 Colorado State U., Fort Collins
CUMULUS CONVECTION AND OROGRAPHIC CONVECTION CELLS Fourth Technical Report, 1 Dec. 1963–31 May 1964
Herbert Kiehl [1964] 27 p refs
(Contract DA-36-039-SC-89080)
(Rept.-4; AD-445225)

Research in regard to Southeast Asia regions continues under two topics: (1) onset of the Asiatic summer monsoon; and (2) synoptic study of monsoon rainfall. Onset of the Asiatic summer monsoon is related to west to east wind changes (300 to 100 mb), 500-mb zonal wind change, and longitudinal displacement of 500-mb mean troughs and ridges. High or low rainfall days appear related to intensification or weakening of the subtropical high over China. Author

N64-33766 Johannes Gutenberg-Universität, Mainz (W. Germany) Meteorologisch-Geophysikalisches Inst.
THE MODIFICATION OF AEROSOL SIZE DISTRIBUTION IN THE ATMOSPHERE Final Technical Report, 1 Jul. 1963–30 Jun. 1964
Christian Junge Jul. 1964 93 p refs
(Contract DA-91-591-EVC-2979)
(AD-445873)

One of the most important processes is the coagulation of aerosol particles by Brownian motion, which is always in operation inside and outside of clouds. Smoluchowski's expression for this process is evaluated for various model distributions of atmospheric aerosols. The results indicate that particles smaller than 10^{-6} cm radius disappear rapidly but that the concentration of particles larger than 10^{-5} cm is not much influenced. An attempt is made of a quantitative formulation of all those processes that modify the aerosol distribution in the course of condensation cycles. Important parameters that enter the calculations are the fraction of tropospheric air occupied by clouds, the number of condensation cycles, the lifetime of clouds, and the concentration of cloud droplets. The calculations are performed for various combinations of these parameters. Author

N64-33793 Chicago U., Ill.
TABLES OF SCAN NADIR AND HORIZONTAL ANGLES
William D. Bonner Jul. 1964 56 p refs
(Grant CWB-WBG-6)
(SMRP Res. Paper-31; AD-446295)

Tables are presented that may be used in place of the tilt and radiometer grids in the Fujita technique for the analysis of satellite radiation data. Scan geometry is briefly described, and an example is given showing the use of the tables in plotting a scan line on an OEC projection. Author

N64-33835 Buenos Aires U. (Argentina)
INVERSION OF THE Ω-EQUATION Final Report
T. N. Krishnamurti (Calif. U.), M. L. Altinger, and O. H. Ciliberti Jul. 1964 33 p refs
(Grant WBG-11)
(AD-603571)

A formal method of inversion of the baroclinic ω equation of the quasi-geostrophic models is proposed. An application to satellite meteorology is suggested, where a 500-millibar surface is obtained in regions of sparse data from a knowledge of the surface map and the vertical motion field. Author

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-33068 Radio Corp. of America, Los Angeles, Calif. Aviation Equipment Dept.
FLIGHT TEST OF MODIFIED DTB AND DME FOR ILS Final Report
28 May 1964 42 p refs
(Contract FAA-ARDS-585)
(AD-602743) OTS: $2.00

The tests were made by measuring the slant distance between the aircraft and the ground beacon, at the instant when

the aircraft passed over an accurately surveyed ground check point. The measurements were made by crystal-controlled timing equipment of high accuracy that measured the time of arrival of the reply pulse. The passage of the aircraft over the ground check point was established by an optical drift sight. Simultaneous photographs of the check point and the display of the timing device were taken. Author

N64-33082* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT EVALUATION OF SOME EFFECTS OF THE PRESENT AIR TRAFFIC CONTROL SYSTEM ON OPERATION OF A SIMULATED SUPERSONIC TRANSPORT
Donald L. Hughes, Bruce G. Powers, and William H. Dana Washington, NASA, Nov. 1964 19 p refs
(NASA-TN-D-2219) OTS: $0.50

The results of the investigation indicate that general piloting problems associated with flying the supersonic transport profile appear to be minor, limited primarily to speed and altitude fluctuation during the high-speed–high-altitude portion of the profile and overshoot tendencies during level-offs from steep portions of the climb. The critical effect of temperature on climb and acceleration performance during the program emphasized the need for including temperature–altitude information in weather forecasts to be used for supersonic transport flight planning. Integration of the single test airplane, used to simulate a supersonic transport, resulted in only minor compatibility problems with the Air Traffic Control system. Author

N64-33335* Control Data Corp., Minneapolis, Minn. Research Div.
FEASIBILITY STUDY OF A TRACK-WHILE-SCAN NAVIGATION CONCEPT Final Report
J. E. Carroll, R. L. Lillestrand, B. D. Vannelli, D. C. Harrington, C. B. Grosch et al 20 Apr. 1964 372 p refs
(Contract NAS1-2902; Control Data Proj. 9552)
(NASA-CR-59297) OTS: $7.00 fs; $2.00 mf

Presented are the results of studies performed. The navigation concept consists of a scanning wide-angle camera with slits positioned on its focal surface, of equations for rigid-body rotation and planetary triangulation, and of onboard computer processing of the camera data to obtain navigational information. The efforts were devoted to the areas of optical, electrical, and mechanical design; error analysis, both by means of computer simulations and analytical studies; and the determination of computer requirements, such as word and length, memory size, and execution time needed to identify the scanned targets, as well as extract navigational information. Author

N64-33353 Federal Aviation Agency, Palmsdale, Calif.
FEDERAL AVIATION AGENCY AIRSPACE ADVISORY, FALLON, NEVADA, OCTOBER 26, 1963. VELA UNIFORM Final Report
H. M. Vick and A. D. Carter 30 Oct. 1964 15 p Sponsored by ARPA and AEC
(Project Shoal)
(VUF-1017) OTS: $1.00

Outlined is the procedure of advising aircraft of a potentially hazardous airspace through which a radioactive airmass would have been expected to move if an underground nuclear shot had vented. Included is a list of the technical reports scheduled for issuance by agencies participating in Project Shoal. R.L.K.

N64-33935 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HOMING GUIDANCE OF ROCKETS
V. I. Kurotkin and V. L. Sterligov 25 Sep. 1964 98 p refs Transl. into ENGLISH of the book "Samonavedeniye Raket" Moscow, Voyennoye Izd. Min. Oborony SSSR, 1963
(FTD-MT-64-198; AD-607316)

Different methods of homing guidance are discussed in popular form. Radar, thermal, optical, and sonic homing devices are described. General principles of the homing-guidance system are discussed, and the methods of direct guidance, of guidance by pursuit path, of guidance with constant lead angle, and of guidance with continuous lead are presented. Active and semiactive radar homing-guidance systems, passive infrared, optical, and acoustic homing-guidance systems, and systems for antimissile missiles are discussed. D.E.W.

N64-34009 Joint Publications Research Service, Washington, D.C.
SCIENTIFIC CONFERENCE ON AGRICULTURAL METEOROLOGY
Hsu Chi-ch'ang *In its* Transl. on Communist China's Sci. and Technol., No. 116 21 Oct. 1964 p 50–55 (See N64-34008 24-07) OTS: $3.00

Papers presented at the conference primarily discussed the following subjects: meteorological conditions for the growth and production of various crops (paddy rice, wheat, cotton, etc.); agricultural weather conditions (drought indexes, utilization of weather reports, etc.); control of climatic conditions in the fields; insect damage and climatic conditions; and forest climates. P.V.E.

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-32700 Oak Ridge National Lab., Tenn.
METALS AND CERAMICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1964
Sigfred Peterson, ed. Oct. 1964 314 p refs
(Contract W-7405-ENG-26)
(ORNL-3670)

The report is divided into four parts: (1) "Fundamental Research"; (2) "Long-Range Applied Research"; (3) "Reactor Development Support"; and (4) "Other Program Activities." Part I includes basic research on sintering, crystal physics, electron microscopy, and X-ray diffraction research. Part II has reports on fuel-element development, high-temperature materials, reactions in solids, tungsten metallurgy, and zirconium metallurgy. In Part III, progress is reported in advanced test reactors, Army reactors program, gas-cooled reactor program, high-flux isotope reactor, and the space power program, among others. The thermonuclear project, transuranium program, and ANPO-C Nerva-program assistance are discussed in Part IV. A.W.

N64-32790 Turku U. (Finland) Astronomia-Optika Inst.
COMPARISONS OF METERS IN FUSED QUARTZ [COMPARAISONS DES METRES EN QUARTZ FONDU] Informe No. 29
Y. Vaisala and L. Oterma 1964 29 p refs *In* FRENCH

A new comparator for determining meter standards is described. The results demonstrate that meter standards of fused quartz can be realized with a precision of about 10^{-8}, which is sufficient for actual use. The reciprocal changes in the meters are relatively small—on the order of 0.1 micron in 10 years. Comparisons of older measurements with the new laboratory standard are under way. M.P.G.

N64-32795 California U., Livermore Lawrence Radiation Labs.
COMPRESSIBILITY OF LIQUID HYDROGEN AT 40,000 ATMOSPHERES AND 1100°K
M. Van Thiel and M. Wasley Mar. 1964 33 p refs
(Contract W-7405-ENG-48)
(UCRL-7833) OTS: $0.75

Liquid hydrogen with an initial density of 0.0710 g/cm^3 at 20.5° K was compressed to a density of 0.192 g/cm^3. Using available thermodynamic data, a calculation of the Hugoniot path was made, which showed that the compressibility is higher than would be expected from the commonly useful linear extrapolation of the Hugoniot curve in the shock-particle velocity plane. Further calculations of the melting lines in the PV plane and the heat capacity showed that the Hugoniot path was completely in the liquid phase and that the temperature of the compressed fluid was 1100° K. Uncertainties in estimating thermodynamic data in the range where measurements are lacking are discussed in line with these calculations. Author

N64-32806 Joint Publications Research Service, Washington, D.C.
IONIZATION STUDIES OF METALS
6 Oct. 1964 36 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Moscow), v. 34, no. 8, Aug. 1964
(JPRS-26723; TT-64-41980) OTS: $2.00

CONTENTS:
1. SURFACE IONIZATION OF METALS IN AN ELECTRIC FIELD G. M. Pyatigorskiy p 1–10 refs
2. LOW-VOLTAGE ARC IN CESIUM VAPORS Yu. K. Gus'kov, M. A. Lebedev, and I. P. Stakhanov p 11–25 refs
3. IONIZATION OF SOME RARE EARTH ELEMENTS ON THE SURFACES OF TUNGSTEN, RHENIUM, AND IRIDIUM N. I. Alekseyev and D. L. Kaminskiy p 26–33 refs

N64-32808 North Carolina State Coll., Raleigh
RESONANT OSCILLATIONS Final Report, 15 Jul. 1963–14 Jul. 1964
Raimond A. Struble 24 Jul. 1964 16 p refs
(Contract DA-ARO(D)-31-124-G450)
(AROD-4105-7; AD-603504)

This article pertains to the prediction of the response of a frictionless nonlinear oscillator to periodic excitation by the method of the resonant oscillations of the Duffing equations. This theory is developed, and it was found that the general solution of the Duffing equation is essentially as predicted by the formal methods of analysis. G.G.

N64-32862 New York U., N.Y. Radiation and Solid State Lab.
ENERGY TRANSFER DURING TRANSIENT NUCLEAR PULSES Progress Report, 1 Mar.–31 Aug. 1963
Hartmut P. Kallmann Nov. 1963 20 p refs
(Contract DA-36-039-SC-89180)
(PR-3; AD-425904)

This article pertains to the mechanism of the interaction between high-energy radiation and insulators. Experiments were conducted with a 2-mm- and a 1-mm-thick anthracene crystal. From the measurements of ionization produced by ultraviolet light and an electric field, a model of how the charges are created and distributed was developed. Experiments with a mylar barrier of varying thickness showed how this mylar ionization contributed to the charge. G.G.

N64-32870 Lowell Technological Inst. Research Foundation, Mass.
EFFECTS OF EXTERNAL FORCES ON VIBRATING CRYSTAL PLATES Fourth Quarterly Report, 1 Feb.–30 Apr. 1964
Charles R. Mingins, Robert W. Perry, and Luther C. Barcus [1964] 35 p refs
(Contract DA-36-039-AMC-02239(E))
(Rept.-12; AD-444331)

Further research is reported dealing with the reaction of oscillating quartz plates to the setting up of steady stresses, in either tension or flexure; the stress coefficient of frequency tends to remain constant under a variety of conditions. Rectangular AT piezoids of exaggerated length have been employed with beneficial effects upon the uniformity of the force field. Rectangular electrodes also afford some control of the strain distribution. The reverse bending in rectangular plates is compared with that in circular plates. Experiments have been performed in applying tensile forces to a circular plate. Progress in the development of applicable theory is reported. Author

N64-32871 Naval Radiological Defense Lab., San Francisco, Calif.
PHOTOGRAPHIC DETECTION OF FAST NEUTRONS: APPLICATION TO NEUTRON RADIOGRAPHY
E. Tochilin 21 Jul. 1964 27 p refs
(USNRDL-TR-766; AD-444935)

The response of photographic emulsions to fast neutrons has been studied by direct measurements at two neutron energies and by exposure to high-energy charged particles. Dose response was significantly less for neutrons than for gamma rays and decreased progressively with decreasing neutron energy. Increased neutron sensitivity was obtained by use of organic scintillators as intensifying screens in conjunction with film. Neutron radiographs at two different energies were taken with step wedges made of Al, Cu, Pb, and plastic. Radiographs were taken behind 2, 4, 6, and 8 inches of lead. Loss of photographic resolution from gamma rays produced in the test sample and by thermal neutron interactions is discussed. Author

N64-32891* Massachusetts Inst. of Tech., Cambridge Aerophysics Lab.
A STUDY OF ATMOSPHERIC EFFECTS ON SONIC BOOMS Technical Report 89
Manfred P. Friedman Apr. 1964 82 p refs
(Contract NAS1-2511)
(NASA-CR-58843) OTS: $3.00 fs; $0.75 mf

An approach to the problem of a shock propagating through a variable atmosphere is presented. A previously presented theory has been improved, and a computer program has been written using the results of the improved theory. This paper presents the improved results and gives a detailed description of the computer program. For an atmosphere that varies arbitrarily in the vertical direction and for a supersonic aircraft with arbitrary lift and volume distribution, the computer program will give the shock overpressure and intersection points at the ground. In addition, effects due to aircraft acceleration, flight path angle and curvature, and acoustical cutoff are computed and presented by the program. Author

N64-32944 Aeronautical Research Council (Gt. Brit.)
A NOTE ON THE SOUND FROM WEAK DISTURBANCES OF A NORMAL SHOCK WAVE
Alan Powell (Southampton U.) London, HMSO, 1955 12 p refs
(ARC-CP-194) HMSO: 1s 6d

The disturbances of a shock wave by sound waves or temperature fluctuations is studied in one dimension to a first-order approximation. In general, both sound waves and temperature fluctuations arise behind the shock wave. Expressions are given for their amplitudes, and calculated for $\lambda = 1.4$. Sound waves colliding with the shock wave are amplified, but sound waves are almost annihilated by weak shock waves if originally traveling in the same direction as the shock wave. Small temperature fluctuations give rise to much sound on an acoustical scale. Author

N64-32996* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A FIBER OPTICAL SYSTEM FOR SPACE APPLICATION
Robert Y. Wong 31 Aug. 1964 31 p refs
(Contract NAS7-100)
(NASA-CR-59183; JPL-TR-32-646) OTS: $2.00 fs; $0.50 mf

A theoretical analysis of dielectric fiber transmission efficiency was performed, and the resulting data were computed and utilized in a fiber optical system design, with the image quality treated as a function of the resolving power of the fiber optic. Also, a theoretical analysis of the contrast, resolution characteristics, and image-quality factors of the fiber optics was made. In tests and experiments, this fiber optical system was found to be suitable for space application. G.G.

N64-33004 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
EFFECTS OF A STATIC MAGNETIC FIELD ON THE CHARACTERISTICS OF A HELIUM-NEON LASER
Paul Fenster Apr. 1964 38 p refs
(Grant AF-AFOSR-453-63)
(PIBMRI-1222-64; AD-601694)

The application of even modest magnetic fields to the amplifying material in the helium–neon laser profoundly modifies the operational characteristics of the laser. The magnetic field introduces a Faraday effect and a Zeeman effect. Both of these effects tend to reduce the power output of the laser. A simple theory is set forth that describes the impact of these effects on the output. The experimental work carried out with a laser oscillating at a wavelength of 6328 Å is generally in agreement with the theory. An attempt is made to explain some observed deviations from the expected results. Author

N64-33006 Rochester U., N.Y.
PHOTOPRODUCTION OF STRANGE PARTICLES AND UNITARY SYMMETRY
S. Hatsukade, L. K. Pandit, and A. H. Zimerman (Kyoto U.) 3 Sep. 1964 11 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-52)

In following "the eightfold way" of unitary symmetry, the coupling constants of the K-meson (interacting with baryons) turn out to be of the order of the pion coupling constants; whereas, experiments on photoproduction of the K seem to suggest that they are smaller, approximately by an order of magnitude. Acceptance of the Goldberger–Treiman-type relations, obtained on the assumption of the dominance of the K and π poles in the leptonic decays of baryons, forces the conclusion that the K-coupling constants must be nearly as large as those given by unbroken unitary symmetry. One possibility of reconciling the conclusions, based on the Goldberger–Treiman-type relations, with the data on the photoproduction of K and Λ from protons is that there may actually be present dynamical cancellations due to some particle (or resonance) states known or unknown, thereby allowing the K-coupling constants to be larger and near the unitary symmetry values. It is proposed that such a cancellation can be achieved. P.V.E.

N64-33009 Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant
THE ELEMENTS OF NEUTRON INTERACTING ARRAYS. PART I: UNREFLECTED, HOMOGENEOUS ARRAYS OF URANIUM METAL AND URANIUM SOLUTION MATERIALS
C. E. Newlon 13 Oct. 1964 44 p refs
(Contract W-7405-ENG-26)
(K-1619) OTS: $1.00

In the current investigation of neutron interacting arrays, consideration has been given specifically to arrays whose units are individually safe for diffusion plant operations and to the derivation of optimum spacing criteria for these units. The report covers work concerned with homogeneous arrays of interacting uranium solution units, in air, and also includes results for arrays of high density uranium metal units. From the mass-volume relations developed from the calculations, it appears that, for equal volume arrays, the minimum critical U-235 mass will occur at an intermediate U-235 enrichment appreciably lower than the 93% level at which the single unit minimum critical mass is normally found. Author

N64-33070 Rochester U., N.Y.
ALGEBRAIC TABULATION OF CLEBSCH-GORDAN COEFFICIENTS OF SU_3 FOR THE PRODUCT $(\lambda, \mu) \otimes (1,1)$ OF REPRESENTATIONS OF SU_3
J. G. Kuriyan, D. Lurié, and A. J. MacFarlane 2 Oct. 1964 41 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-56)

A algebraic tabulation is made of the Clebsch–Gordan coefficients of SU_3 that occur in the reduction into irreducible representations of the direct product $(\lambda,\mu) \otimes (1,1)$ of irreducible representations of SU_3. Full explanation is made of the method of handling the complications associated with the possible double occurrence of the representation (λ, μ) itself in the direct product. The phase convention employed is an explicitly stated generalization of the well-known Condon and Shortley phase convention for SU_2. The relationship of the CG coefficients associated with the direct product $(1,1) \otimes (\lambda, \mu)$ to those coefficients already mentioned is also exhibited. Author

N64-33088 Brown U., Providence, R.I. Div of Applied Mathematics
ESTIMATION OF THE BISPECTRUM
M. Rosenblatt and J. W. Van Ness Jun. 1964 50 p refs
(Contract Nonr-562(29))
(TR-13; AD-601657) OTS: $2.00

This is an examination of the bispectrum as a phenomena of nonlinear character in a higher order theory. The estimation of the weighted and unweighted bispectral density, given as a set of observations of the process, is discussed. The consistency and asymptotic distribution of the estimates are derived for certain classes of processes. A second-order harmonic theory for Fourier–Stieltjes representation in terms of the spectral distribution function is used to form the equations. G.G.

N64-33103 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A METHOD FOR DETERMINING THE RADIAL DENSITY AND TEMPERATURE PATTERN IN HIGH-PRESSURE XENON DISCHARGE

Manfred Worm 28 Aug. 1964 18 p refs Transl. into ENGLISH from Exptl. Tech. Physik (W. Berlin), v. 11, no. 1, 1963 p 51–61

(FTD-TT-64-375/1+2; AD-448333)

The weakness of X-rays when passing through the discharge in the direction of the axis represents a measure for the prevalent density. Investigations were carried out on special types of XF 3000, which differentiates from the ordinary types in that electrodes are mounted vertically to the arc axis. The different lamp design requires that a suitable cooling device be developed. CdS-cells serve as X-ray indicators and are arranged in a compensating circuit. By applying a double differential formation it was possible by means of a calibration curve to convert the partial scale values directly to density or temperature values. Temperatures between 6250° ±380° K and 7580° ±460° K were obtained in the arc axis for the four amperages at an operational pressure of 9 atm. Author

N64-33141 Rochester U., N.Y.

TENSOR METHODS II—MATRIX ELEMENTS OF THE DECUPLET OPERATOR OF SU_3

L. K. Pandit and N. Mukunda 3 Sep. 1964 49 p refs

(Contract AT(30-1)-875)

(UR-875-53)

In continuation of the work presented in an earlier paper on the tensor methods for SU_3, the nonvanishing matrix elements of the "decuplet operator" are derived. Simple derivations of some crossing and symmetry relations for the SU_3 Clebsch–Gordan coefficients are given. It is further shown how the tensor methods lead to a simple understanding of the problem of reduction of direct products of arbitrary UIR's. Author

N64-33142 Rochester U., N.Y.

THREE-FIELD MODEL AND HIGHER SYMMETRY GROUP W_3 WITH PARITY INTERCHANGE

R. E. Marshak, N. Mukunda, and S. Okubo 25 Sep. 1964 40 p refs Submitted for Publication

(Contract AT(30-1)875)

(UR-875-55)

A theory of hadrons (strongly interacting particles) based on the higher symmetry group $W_3 = U_3 \otimes U_3$ (or $SW_3 = SU_3 \otimes SU_3$) with parity interchange between the two U_3 (or SU_3) groups has been developed. The four-fermion vector model with three massless Dirac fields has been used to guide the construction of the meson and baryon particles. A parity doublet structure in the W_3 (or SW_3) limit is found for the mesons but not for the baryons. Mass relations between scalar (axial vector) and pseudoscalar (vector) octets or nonets of mesons are derived under various assumptions concerning the underlying group, the tensorial behavior of the symmetry-breaking terms, and the particle representations. Some experimental tests of these mass relations are noted. The possibility of incorporating the leptons into the theory is discussed. Author

N64-33163* Ohio State U. Research Foundation, Columbus Antenna Lab.

RADIATION FROM HARMONIC SOURCES IN A UNIFORMLY MOVING MEDIUM

R. T. Compton, Jr. and C. T. Tai 5 Aug. 1964 14 p refs *Its* Rept.-1691-9

(Grant NsG-448)

(NASA-CR-59185) OTS: $1.00 fs; $0.50 mf

Minkowski's results are used to find a general integral for the field equations in a moving medium. The medium is assumed to be homogeneous, isotropic, and to move with a constant velocity much less than the speed of light, inside a certain volume of space. Only time harmonic fields are considered. A wave equation for the electric field is derived and is integrated by means of a Green's identity and an appropriately defined dyadic Green's function. The result gives the electric field inside the volume in terms of known sources in the volume and the tangential components of the electric and magnetic fields over the enclosing surface. The fields radiated by a point dipole in an infinite moving medium are found. Author

N64-33164* IIT Research Inst., Chicago, Ill. Technology Center

INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Quarterly Report, Apr. 1–Aug. 1, 1964

Gene A. Zerlaut, V. Raziunas, and S. Katz 5 Sep. 1964 39 p refs

(Contract NASr-65(07))

(NASA-CR-59144; IITRI-C6018-11) OTS: $2.00 fs; $0.50 mf

The optical properties of concentrated films of suspensions of silver bromide particles of two narrow-size distributions were established. For the concentrated suspensions in thin films, it has been shown that if the films are monolayers, the interactions due to proximity of scatterers are minimal. However, multiple scattering effects are found if the particles are packed behind each other with respect to the incident beam. In dilute systems the particles of two sizes act as independent scatterers. On the basis of experimental data, a theoretical optimum paint coating was constructed in order to attain minimum interactions between the scatterers. Author

N64-33168* Wheeler Labs., Inc., Great Neck, N.Y.

A MACROSCOPIC WAVEGUIDE MEDIUM FOR LASER SYSTEM COMPONENTS

E. R. Schineller, D. W. Wilmot, and H. M. Heinemann 10 Jun. 1964 81 p refs *Its* Rept.-1209

(Contract NASw-888)

(NASA-CR-58999) OTS: $3.00 fs; $0.75 mf

The initial step in the design of microwave-analogous components is the development of a single-mode optical waveguide large enough to permit component fabrication. Single-mode operation is required to prevent signal distortion due to modal dispersion. A dielectric waveguide for this purpose has been studied, and its feasibility has been demonstrated at optical frequencies. The waveguide dimensions are macroscopic in the sense that they are visible to the naked eye. A single-mode waveguide may be as large as 100 wavelengths with stringent but feasible tolerances on dielectric constant and surface quality. Single-mode and controlled multimode operation have been correlated with theory. In addition, a survey of materials and fabrication techniques has been made. Author

N64-33169* Wisconsin U., Madison Theoretical Chemistry Inst.

UPPER AND LOWER BOUNDS FOR RAYLEIGH-SCHRODINGER PERTURBATION ENERGIES

Kenneth M. Sando and J. O. Hirschfelder 28 Feb. 1964 20 p refs

(Grant NsG-275-62(4180); Contract AF 33(657)-7311)

(NASA-CR-58965; WIS-TCI-39) OTS: $1.00 fs; $0.50 mf

Variational principles for upper and lower bounds to all even-order Rayleigh–Schrödinger perturbation energies are given. The upper bound for the second-order energy is the Hylleraas principle, and the upper bounds for energies through 12th order are the same as those used by Knight and Scherr. The general upper bound principle for the (2n)th order energy is equivalent to the variational principle obtained by Sinanoglu for the n-th order wave function, but the principle gives the exact (2n)th order energy when the trial wave function is exact. The lower bounds for the even-order energies are generalizations of the lower bound obtained by Prager and Hirschfelder for the second order. Author

N64-33178* Wheeler Labs., Inc., Smithtown, N.Y.
DEVELOPMENT OF MACROSCOPIC OPTICAL WAVEGUIDE COMPONENTS Seventh Progress Report, Sep. 1964
E. Ronald Schineller 20 Oct. 1964 4 p refs
(Contract NASw-888)
(NASA-CR-59160) OTS: $1.00 fs; $0.50 mf

Analysis of an optical interference filter constructed in the waveguide medium was made, and the ambiguity between spatial and frequency filtering was removed. The characteristics of a long slot directional coupler consisting of two bisected waveguides were calculated. The experimental testing of a waveguide modulator with nitrobenzine as a liquid core was continued. G.G.

N64-33188* Maryland U., College Park
SOME CURRENT AND PROPOSED THEORETICAL STUDIES OF GRAVITY AT THE UNIVERSITY OF MARYLAND Progress Report, Appendix B, 1 Jan.–30 Jun. 1964
C. W. Misner Feb. 1964 8 p refs
(Grant NsG-436)
(NASA-CR-58984) OTS: $1.00 fs; $0.50 mf

This paper contains theoretical descriptions of highly condensed bodies involving strong gravitational fields, and their gravitational radiation. The reduced output of gravitational radiation below the linear theory prediction by nonlinearities of the gravitational field and the maximum power output and frequency for a binary collapsed star system are studied. The following topics were investigated: "Maximum Static Equilibrium Cold Mass"; "Static Solutions with Axial Symmetry"; "Stationary Equilibria for Rotating Fluids"; and "Gravitational Radiation-Redshift Cut-Off." G.G.

N64-33205* General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
GAMMA-RAY SPECTRA ANALYZED BY COMPUTER PROGRAM USING THE PEAK AREA METHOD
S. C. Choy and R. A. Schmitt 10 Aug. 1964 50 p refs Submitted for Publication
(Contract NASw-843)
(NASA-CR-58970; GA-5233) OTS: $2.00 fs; $0.50 mf

A computer program has been devised for use in gamma-ray spectroscopic analysis that yields elemental concentrations in parts per million and their standard deviations due to counting statistics from the observed peak areas (Compton continuum subtracted). In the computer analysis, radioisotopes may be identified by ratios of the peak areas of two or more gamma rays. Author

N64-33235 Argonne National Lab., Ill. Metallurgy Div.
NEUTRON RADIOGRAPHY Summary Report
Harold Berger Jul. 1964 31 p refs
(Contract W-31-109-ENG-38)
(ANL-6846) OTS: $0.75

This development program covers techniques of neutron radiography and their applications. The difference of relative absorption rates of neutrons and X-radiation in materials is used for inspection of large thicknesses of heavy materials; for the detection of hydrogen, lithium, or boron in heavy materials; and for better radiographic discrimination between neighboring materials in the periodic table. G.G.

N64-33239 California U., Livermore, Lawrence Radiation Lab.
YOGI-G: A GAMMA RAY MONTE CARLO PROGRAM
Simon Kellman 4 Aug. 1964 160 p refs
(Contract W-7405-ENG-48)
(UCRL-12005)

YOGI-G is a gamma-ray Monte Carlo program written in FORTRAN II language for the IBM 7090/7094 computer with LRL monitor control. The code computes gamma-ray energy deposition in selected rectangular and cylindrical systems. In relatively simple geometries, the program processes more than 5000 collisions per minute. Pair production, Compton collision, and photoelectric absorption processes are treated. Energy transferred to electrons in these processes is assumed to be absorbed at the point of collision since the ranges of the electrons are small. Energy deposition per zone and the corresponding variance are computed. In addition to the straight tally, two expected-value calculations of gamma energy absorption in each zone and in each energy sector of every material region are available in order to improve statistical accuracy. Author

N64-33244 Kaman Aircraft Corp., Colorado Springs, Colo. Kaman Nuclear Div.
NEUTRON SHIELDING INVESTIGATIONS Technical Progress Report, 28 Dec. 1963–27 Jun. 1964
William J. Rudy et al 20 Jul. 1964 31 p ref
(Contract ARPA-SD-135; ARPA Order 343-62)
(KN-684-64-13; AD-444093)

The investigations showed that the experimental traverses compare reasonably well with the calculated curves, although the data are not very complete. The shield thickness of 12 inches was chosen to provide, approximately, a factor of 10 attenuation, and this attenuation was confirmed within a factor of 2, depending on the energy sensitivity of a proposed weapon. A thick and heavy shield, for instance, is necessary to provide neutron hardening as high as a factor of 10. The shielding material used was polyethylene containing about 11% boric acid by volume. A.W.

N64-33248 New York U., N.Y. College of Engineering
A SURVEY OF DEVICES FOR MONITORING X-RADIATION
Mar. 1963 23 p
(Proj. SETE)
(SETE-228/4)

The existing methods of monitoring X-radiation are surveyed, their operation and limitations are described, and portable military and commercial devices for detecting and measuring x-radiation are tabulated. Specific subjects covered include area and personnel monitoring; the measurement of x-radiation with calorimetric, ionization, solid state, photographic, and chemical dosimetry devices; and measurement difficulties and limitations. D.E.W.

N64-33265 Stanford U., Calif.
NUCLEAR STRUCTURE Final Report, 1 Jan. 1955–31 Mar. 1964
W. E. Meyerhof May 1964 7 p refs
(Contract Nonr-225(19))
(AD-600874)

The report contains a summary of four major research programs. The programs are classified as studies of nuclear

magnetic resonance, of atomic spectroscopy, of low-temperature phenomena, and of nuclear structure. Brief résumés are given of each study, as well as the results obtained from each. A.W.

N64-33266 Atomic Energy of Canada Ltd., Chalk River, Ontario

A REVIEW OF DIFFUSION PARAMETERS FOR THERMAL NEUTRONS IN LIGHT AND HEAVY WATER WITH AN APPENDIX ON THE THERMAL NEUTRON ABSORPTION IN BORON

R. G. Jarvis Aug. 1964 61 p refs
(AECL-2072; CRRP-1203) Atomic Energy of Can. Ltd., Chalk River, Ontario: $1.50

This report is concerned with the values of the thermal neutron-diffusion parameters for light water and heavy water. It contains a brief review of the more recent experiments and a comparison of their results with the predictions of simple theories. A consistent set of values is derived for transport cross sections, absorption cross sections, and thermal diffusion areas, and the errors are estimated. The thermal neutron-absorption cross sections for boron are discussed. Author

N64-33291* Maryland U., College Park

GRAVITATIONAL RADIATION FROM BINARY SYSTEMS Progress Report, Jan. 1–Jun. 30, 1964

C. V. Vishveshwara [1964] 14 p
(Grant NsG-436)
(NASA-CR-59249) OTS: $1.00 fs; $0.50 mf

The variation of the separation r and the angular velocity of rotation ω are investigated for two bodies of masses m_1 and m_2 moving in circular orbits about their common center of mass and acting as a source of gravitational waves that reduce the total energy of the system at a rate ($-de/dt$). A formula for power loss to gravitational radiation is derived and applied to astronomical bodies. It is concluded that a binary system that has evolved out of the fission of a star can act as a powerful source of gravitational radiation, the rate of radiation increasing to values much higher than the initial luminosity within a short period of time. A comparison with radiation from spheroidal stars shows the importance of the effect of density on the emission rate of gravitational energy. M.P.G.

N64-33300 Illinois U., Urbana Antenna Lab.

BEAM TRACING AND APPLICATIONS

Georges A. Deschamps and P. E. Mast Jun. 1964 42 p refs
(Contract AF 33(657)-10474)
(TR-79; AD-605529)

Graphical methods are introduced to describe the transformations of a beam as it goes through an optical system. The beams considered are defined by a real gaussian distribution of the field at some reference cross section but can also include higher order modes defined by hermite–gaussian functions, or the "beam-modes" considered by Goubau. A complex variance is introduced that describes at once the effective area of a cross section of the beam and the curvature of its phase front. In free space propagation, and at the crossing of a lens, the complex variance transforms in a simple manner which may be compared to impedance transformation through a reactive ladder network. The graphical constructions make it possible to trace the variations of a beam cross section and curvature through a system. Author

N64-33313 California U., Berkeley Inst. of Engineering Research

A PRINCIPLE OF MAXIMUM UNIFORMITY OBTAINED AS A THEOREM ON THE DISTRIBUTION OF INTERNAL FORCES

Paul Lieber Apr. 1963 17 p refs
(Contract Nonr-222(87))
(MD-63-8; AD-605570)

This paper identifies and establishes a fundamental theorem on the spatial-global and temporal-local distribution of internal forces for a class of dynamical systems that includes the Maxwell gas. The theorem is based on a formulation of the Gauss–Hertz principle of mechanics where concept force is retained and underlined. Within the framework of Gauss' mechanics a new and fundamental global property of internal forces bearing on cooperative phenomena is found that can be expressed as a principle of maximum uniformity. Doing so, however, requires a demonstration of the validity of Gauss' principle for all known categories of geometrical constraint. This is done, and attests to generality and power of principle. The information rendered explicit by the theorem cited is not discernable or obtainable from Newtonian mechanics without quadrature. Author

N64-33333* Stevens Inst. of Tech., Hoboken, N.J.

SPECULAR REFLECTION OF PHONONS IN SUPERFLUID HELIUM AT 0.33°K

J. Fajans and C. Z. Rosen [1961] 8 p refs
(Grant NsG-130-61; Contract AF 49(638)-352)
(NASA-CR-59293) OTS: $1.00 fs; $0.50 mf

Specular reflection of phonons was observed in superfluid helium at 0.33° K. The temperature was obtained by the He^3 refrigerating system. The phonons were generated at a small carbon transmitter and traveled along various directions in the experimental chamber without colliding with other phonons. Some went directly to a concave, fused quartz mirror where they were specularly reflected. When the mirror was sharply focused so that the carbon receiver was confugate to the carbon transmitter, an enhanced signal 14 times greater than the unfocused phonon background signal was recorded. Thus, phonons were directly "manipulated", simply by means of a spherical mirror, to form the heater image at the carbon detector. A.W.

N64-33346 Joint Publications Research Service, Washington, D.C.

EXCERPTS FROM "LASERS IN SPACE, ON THE GROUND, AND UNDER WATER"

V. N. Chernyshev 30 Oct. 1964 16 p Transl. into ENGLISH of excerpts from the booklet "Lazery v Kosmose, Na Zemle, i Pod Vodoy" Moscow, Voyenizdat, 1964, p 90–101
(JPRS-27167; TT-64-51423) OTS: $1.00

The development in the United States of lasers as potential weapons to be used against ballistic missiles or against personnel is discussed. The scientific and industrial applications to which lasers may lend themselves are explored. Some of the applications are in communications, high-speed memories, welding and cutting, fusion or evaporation, power transmission, high-resolution photography, frequency standards, chemical reaction control, and surgical operations. Current trends of thought in the press are noted, and the widespread interest in lasers is indicated. D.E.W.

N64-33350 Aberdeen Proving Ground, Md. Terminal Ballistics Lab.

DETERMINATION OF NEUTRON FIELD CHARACTERISTICS USING THE HELIUM-3 SOLID STATE SPECTROMETER

T. Jeter, A. Manning, and H. Schuckler Apr. 1964 12 p refs
(BRL-1565; AD-444736)

The helium-3 solid-state spectrometer is used to determine the energy spread and homogeneity of the neutron field produced by high-voltage accelerators. A number of spectra are discussed that illustrate the usefulness of this method. Author

N64-33375 Naval Civil Engineering Lab., Port Hueneme, Calif.
DETERMINATION OF DAMPING CONSTANTS FOR A DRY FRICTION-VISCOUS DAMPED OSCILLATOR
D. A. Da Deppo 3 Aug. 1964 28 p refs *Its* Tech. Note N-598 (AD-445028)

The method of least squares is applied to the problem of analyzing a decay record to determine the damping constants for a dry-friction viscous-damped, single-degree-of-freedom system. Solution of the set of nonlinear equations that yield the constants is obtained by applying the Newton–Raphson method of iteration. Sample calculations show that the method is not well suited for manual computation. A program is presented for calculating the damping constants by means of a digital computer. Author

N64-33379* Consultants and Designers, Inc., Arlington, Va.
THE INVARIANT METHOD OF SOLVING THE PROBLEM OF ELECTROMAGNETIC WAVE PROPAGATION IN A UNIFORM GYROTROPIC MEDIUM [K VOPROSU O RASPROSTRANENII ELEKTROMAGNITNYKH VOLN V ODNORODNOY GIROTROPNOY SREDE]
I. A. Biryulin 13 Oct. 1964 8 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 4, 1964 p 29–33
(Contract NAS5-3760)
(NASA-TT-F-8971; ST-RWP-AI-10220) OTS: $1.00 fs; $0.50 mf

The question of electromagnetic waves' propagation in a uniform gyrotropic medium of the ionosphere type is considered on the basis of the invariant method. A new form is given to the dispersion formula of the ionosphere, which stems from the given method. Author

N64-33417 Naval Civil Engineering Lab., Port Hueneme, Calif.
ATTENUATED TOTAL REFLECTANCE SPECTROSCOPY OF PAINT VEHICLES
R. J. Mc Gowan 15 Apr. 1963 24 p refs
(R-240; AD-404468)

Certain problems are encountered in using infrared transmission spectroscopy for the quantitative evaluation of paint vehicles; therefore, an investigation of attenuated total reflectance spectroscopy was conducted. In thin-film analysis, it is very difficult, if not impossible, to know the sample thickness, knowledge of which is essential in quantitative infrared transmission spectroscopy. The attenuated total reflectance technique eliminates this problem. Therefore, it was concluded that this method is superior to transmission measurements for quantitative evaluation of paint vehicles. Author

N64-33429 Rochester U., N.Y.
FINITE QUANTUM ELECTRODYNAMICS: A FIELD THEORY USING AN INDEFINITE METRIC
M. E. Arons, M. Y. Han, and E. C. G. Sudarshan 1 Aug. 1964 85 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-54)

Two auxiliary fermion fields with anticommutation relations of opposite sign from the normal fermion field (electron) are coupled with the electron to the electromagnetic field in a manner so that any matrix element, calculated by a perturbation expansion, is finite. Although the new Lagrangian is not explicitly gage invariant, the electromagnetic field is quantized by a method that yields a propagator in the true Landau gage, and it is shown that this is sufficient to insure that the physical vector particles are zero-mass transverse quanta (i.e. photons). The physical electron mass and the fine structure constant are put into the theory, leaving only the masses of the two auxiliary fields as parameters. The effects of mass and charge renormalization are calculated (the former using a technique involving a Taylor expansion in the mass), and are required to be small so that there is no explicit contradiction to the validity of the perturbation expansion. Author

N64-33430 California U., Berkeley Lawrence Radiation Lab.
SIMPLE CALCULATIONS OF RESONANCES IN BARYON-MESON TWO-PARTICLE CHANNELS
Shu-yuan Chu 19 Aug. 1964 15 p refs
(Contract W-7405-ENG-48)
(UCRL-11622) OTS: $0.50

The matrix formulation of the N–D method is applied in the static model to the case of n-coupled two-particle channels containing one baryon and one pseudoscalar meson. The N function is approximated by a single pole at the same position for all matrix elements, with residues given by exact SU_3 symmetry. The mass splitting of the $\underline{P}_{3/2}$-baryon decuplet is studied, as well as the effect of the $\kappa\Sigma$ channel on the position of the 3-3 resonance and the πN 3-3 phase shift. Author

N64-33431 American Meteorological Society, Boston, Mass.
IMPROVED EXPRESSIONS FOR THE MATRIX ELEMENTS OF OPERATORS OF SPIN-DEPENDENT INTERACTIONS
A. P. Iutsis, R. S. Dagis, Ia. I. Vizbariate, and S. A. Zhvironite Sep. 1963 20 p refs Transl. into ENGLISH from Tr. Akad. Nauk Litovsk. SSR, v. 3, no. 26, 1961 p 53–66
(Contract AF 19(604)-6113)
(T-R-399; AD-602146) OTS: $1.00

Inaccuracies are indicated in the expressions for two-electron matrix elements of spin interaction. Definitions are presented of radial integrals that express the energy of these interactions between the electrons in an atom, and their characteristics are established. Tables are presented that can be employed to find the correct expressions for the matrix elements of the energy of spin interactions for a number of configurations. Author

N64-33479 Naval Research Establishment, Dartmouth (Canada)
ON THE DETERMINATION OF FAR-FIELD DIRECTIVITY PATTERNS FROM NEAR-FIELD MEASUREMENTS
A. Mohammed and M. S. Narayanan Aug. 1963 14 p refs
(NRE-64/1; AD-445126)

Pachner's analysis on the determination of far-field directivity patterns from near-field measurements has been generalized. A necessary and sufficient condition for the validity of his results has been derived. The reductions of the general results are indicated for transducers whose directivity patterns possess cylindrical symmetry. Author

N64-33483 Technische Hochschule in Wien (Austria) Inst. für Höhere Geodäsie
MULTI-PARAMETER FIGURES OF EQUILIBRIUM. CURVATURE OF THE PLUMBLINE Final Technical Report, 1 Mar. 1963–29 Feb. 1964
K. Ledersteger 5 Mar. 1964 2 p
(Contract DA-91-591-EUC-2838)
(AD-603073)

This paper pertains to a new multiparameter theory of spheroidal figures in hydrostatic equilibrium and the normal spheroids of the earth and the moon. The problem of Stokes' elements is solved, and the physical impossibility of a general equipotential ellipsoid was shown. The rotational velocity—totally independent of equilibrium—is explained as a function of the given mass and of a given external equipotential surface. Investigations on the regularization problem of the earth's crust were started. G.G.

N64-33497 European Atomic Energy Community, Brussels (Belgium)
CARBON TRANSPORT
L. J. Valette Repr. from Ingenieur (The Hague), v. 75, no. 11, 1963 p 39–40 Presented at Nuclear Tech. Div., Koninkl. Inst. van Ingr., The Hague, 6 Apr. 1962
(EUR-516.e)

The problem of carbon transport is defined as the combined removal of graphite from the hot core of the reactor and the back deposition of carbon on metallic components at lower temperature. A brief survey is made of the important variables affecting the carbon transport process, which are oxidation, carbon deposition, purification, inleakage, and outgassing of gaseous impurities. Based on the information available in literature it is shown that the extent of oxidation of graphite is governed by three single processes—the chemical reaction rate, the diffusion of the impurities in the graphite pores, and diffusion of the impurities from the main coolant to the graphite surface. Each of these processes becomes preponderant in different temperature ranges. Some aspects of the corrosion of the Dragon fuel element components are discussed. Author

N64-33523 Naval Radiological Defense Lab., San Francisco, Calif.
DECAY CHARACTERISTICS OF Sr^{93}
V. Akamian 9 Mar. 1964 16 p refs
(USNRDL-TR-733; AD-600172)

The decay characteristics of Sr^{93} were examined by gamma-ray scintillation spectrometry and beta-ray proportional counting. A 7.8-min half-life was derived from the beta-ray decay data in agreement with literature values. The gamma-ray spectra yielded a 7.6 ±0.2-min half-life associated with the four most abundant gamma rays. The gamma-ray energies associated with Sr^{93} in the 0- to 2.56-MeV range are 0.174, 0.257, 0.341, 0.451, 0.590, 0.717, 0.886, 1.02, 1.06, 1.09 1.21, 1.66, 2.13, 2.18, and 2.46 MeV. The relative abundance of the prominent gamma rays are 0.174(30), 0.257(13), 0.590(83), 0.717(31), and 0.886 MeV (100). Evidence of the possible existence of Y^{93m} was noted. Author

N64-33556 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
NUCLEAR-INDUCED AIR-IONIZATION CURRENTS
P. R. Cheever 31 Mar. 1964 64 p refs
(Contract AF 33(657)-7201)
(NARF-63-16T; FZK-9-190; AD-606674)

The results of analytical and experimental investigations of ionization currents for pairs of parallel cylindrical electrodes subjected to 2×10^5 rad/hr of cobalt-60 radiation are compared. Two electric-field assumptions were used to derive two ionization-current equations. Fair agreement was achieved between measured and calculated values. The effects of pressure, voltage, electrode diameter, and electrode separation are illustrated in numerous ionization curves. Author

N64-33561* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SPINOR SOLUTION OF THE SOUND WAVE PROBLEM
Lawrence A. Schmid Jul. 1964 14 p ref
(NASA-TM-X-55085; X-641-64-213) OTS: $1.00 fs; $0.50 mf

The spinor formulation of magnetogasdynamics is applied to the problem of a sound wave in an electrically neutral gas. This simple, one-dimensional problem serves to illustrate the essential features of the formalism. The solution is completely relativistic and, for sound waves of macroscopic wavelengths, satisfies Euler's equation, the continuity equation, and the adiabatic condition. For wavelengths of the order of atomic dimensions, spin-dependent terms, which are completely negligible for macroscopic waves, become important and drastically alter the form of the solution. Thus the spinor solution of the sound wave problem has the desirable feature that it automatically breaks down at the point where classical mechanics breaks down, namely, when the characteristic length of the problem becomes of atomic dimensions. Author

N64-33576 Illinois U., Urbana
THERMAL ELECTRIFICATION OF A CONDUCTING SPHERE
R. C. Dimick and S. L. Soo Aug. 1964 11 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(ILL-15-P; AD-445932)

Charging of a conducting sphere enclosed in a concentric vacuum by thermionic emission as limited by space charge was studied. A method of solution of the integral equation of the electric field is presented. Author

N64-33579 Michigan U., Ann Arbor Inst. of Science and Technology
TIME-FREQUENCY SIGNATURES THROUGH OPTICAL DIFFRACTION SCANNING
Philip L. Jackson Sep. 1963 26 p refs
(Contract AF 49(638)-1078; ARPA Order-292)
(Rept.-4596-17-R; AD-419191)

An optical scanning method has been developed to present frequency content as it occurs and changes throughout a variable-density seismogram. Energy distributions are shown in both frequency and time. A two-dimensional pattern is presented that can be visually evaluated, and is suitable for numerical measurement. This report describes and discusses the method, and gives illustrative examples. It also describes a similar scanning method by which seismic wave dispersions can be revealed and measured. Author

N64-33587 European Organization for Nuclear Research, Geneva (Switzerland) Theoretical Study Div.
ON THE PRODUCTION OF ANTIDEUTERONS
H. Pilkuhn 14 Sep. 1964 19 p refs
(CERN-64-40)

Although the existence of antideuterons is required by elementary particle theory, the antideuteron has not, as yet, been detected. A reaction that might give higher antideuteron production rates than nucleon-nucleon collisions is investigated theoretically. This reaction

$$\bar{p} + p \rightarrow \bar{d} + p + n$$

has the advantage of much lower threshold (6 M laboratory kinetic energy as compared to 16 M for the nucleon-nucleon reaction, where M denotes the nucleon mass). Numerical estimates of this reaction are made for an antiproton momentum of 10 GeV/c, and a probability of 10^{-5} is obtained for antideuteron production. Antideuteron production in nuclei and the possibility of antideuteron production by accelerating deuterons or alpha particles in a proton synchrotron of the 100-GeV/c range are also considered. M.P.G.

N64-33588 Atomics International, Canoga Park, Calif.
THERMAL NEUTRON SPECTRUM EFFECTS ON CALCULATIONS FOR GRAPHITE LATTICES
F. L. Fillmore 15 Oct. 1964 28 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7892)

The effect of the thermal neutron spectrum on the multiplication constant in calculations for graphite-moderated lattices is examined. The point in question is not the theory of calculating the spectrum but rather how to employ spectrum results once they are obtained. The procedure for utilizing experimental flux measurements is also examined, and formulas are developed that are consistent with those of a commonly employed flux-averaging procedure for lattices using theoretical flux results. The average neutron velocity for each region of the lattice cell appears explicitly in these formulas. Results of calculations are given for 6 lattice spacings for a typical uranium–graphite lattice. Flux measurements are available for 3 of these spacings. Two essentially different calculational methods are employed. One of these uses the same neutron spectrum in all regions of the lattice cell while the other uses a different spectrum in each region. Author

N64-33593 General Electric Co., Cincinnati, Ohio Advanced Engine and Technology Dept.
RESEARCH ON JET NOISE GENERATION AND SUPPRESSION Final Report
W. R. Semrau Apr. 1964 249 p refs
(Contract NOw-62-0887-d)
(AD-446344)

Experimental and analytical investigations on jet-noise generation and suppression have resulted in a verification of the concept that jet noise is uniquely related to mean-flow-velocity distribution in the jet wake. Advances have been made in analytical techniques for calculating aerodynamic properties of free jet flow, and the related acoustic properties of the flow and verification of the assumption that negligible attenuation of sound occurs during propagation through multielement jet flows has been achieved. Investigation of selective water injection as a jet-noise suppression scheme has indicated little promise for in-flight noise reduction. Studies of noise generation by high-temperature and high-pressure ratio jets have extended the state-of-the-art in the area of high-temperature flow noise suppression, and have resulted in a means for predicting total acoustic power beyond the limits of applicability of the Lighthill parameter. Author

N64-33625* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTRODUCTION TO THE APPLICATION OF VON ZEIPEL'S METHOD
William J. Wickless Sep. 1964 21 p refs
(NASA-TM-X-55095; X-547-64-247) OTS: $1.00 fs; $0.50 mf

After a summary of the concepts of classical mechanics required to state the problem, the application of Von Zeipel's method in the case of a satellite orbiting under the influence of a gravitational field, plus small perturbations due to the earth's oblateness, is presented. M.P.G.

N64-33636* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DECOMPOSITION OF THE SCHRODINGER EQUATION FOR TWO IDENTICAL PARTICLES AND A THIRD PARTICLE OF FINITE MASS
A. K. Bhatia and A. Temkin Sep. 1964 42 p refs
(NASA-TM-X-55102; X-641-64-270) OTS: $2.00 fs; $0.50 mf

An angular momentum decomposition of the Schrödinger equation is extended to the case noted in the title. (The case of three unequal mass particles is also treated.) The decomposition is effected with the use of a symmetric choice of Euler angles, and the radial equations are given in two useful forms. The radial equations are shown to yield the Born–Oppenheimer equations for H_2^+ in the limit that the two identical particles approach infinite mass. Other aspects of this limit are discussed, and general rules that relate the total angular momentum states of the three-body system with the molecular states of H_2^+ are examined. Author

N64-33674 Illinois U., Urbana Coordinated Science Lab.
ON CERTAIN RELAXATION OSCILLATIONS: ASYMPTOTIC SOLUTIONS
Peter James Ponzo and Nelson Wax Jul. 1964 49 p refs
(Contract DA-28-043-AMC-00073(E))
(R-229; AD-603687)

Periodic solutions of the generalized Liénard equation $\ddot{x} + \mu f(x)\dot{x} + g(x) = 0$ ($\cdot \equiv d/dt$), with $\mu >> 1$, are investigated in the phase and Liénard planes. Certain comparison equations are obtained by modifying the functions f(x), g(x), $F(x) = \int_0^x f(u)du$, so that the resulting equations may be integrated to within an error of order μ^{-2}. The comparison solutions are used to approximate the solution trajectories of the original equations and, in particular, the periodic orbits. The result is an analytic description of the trajectories, in both planes, to order μ^{-2}. The asymptotic form of the amplitude and period, for a periodic orbit, is obtained with errors or order μ^{-2} and μ^{-1}, respectively. Author

N64-33692 Rochester U., N.Y. Inst. of Optics
INVESTIGATIONS OF OPTICAL MASERS Final Report
Robert E. Hopkins Sep. 1964 11 p refs
(Grant DA-ARO(D)-34-124-G324)
(AROD-3309-5; AD-450074)

Research accomplishments in a basic study of ruby-laser emission and in optimum design and construction of visible helium–neon gas lasers are outlined. The initiation of the following studies is also reported: (1) laser radiation-damage studies; (2) design and analysis of Q-switching techniques; (3) optical characteristics of second harmonic radiation generated within nonlinear media; and (4) optimum coupling between the output from a gas laser and various nonlinear media. Accumulated laser-research equipment is being used to introduce lasers in the optics curriculum. M.P.G.

N64-33698* Massachusetts Inst. of Tech., Cambridge
ON THE OPTIMUM QUANTIZATION OF STATIONARY SIGNALS
James D. Bruce Repr. from 1964 IEEE Intern. Conv. Record, Pt. I p 118–124 refs
(Grants NsG-496; NSF G-16526; NIH-G-MH-04737-03; Contract DA-36-039-AMC-03200(E))

An exact expression for the quantization error is formulated as a function of the parameters that define the quantizer, the error-weighting function, and the amplitude probability density of the quantizer input signal. An algorithm is developed that permits the determination of the specific values of the quantizer parameters that define the optimum quantizer. This algorithm, which is based on a modified form of dynamic programing, is valid for both convex and nonconvex error-weighting functions. Examples of optimum quantizers designed with this algorithm for a representative speech sample are presented. The performance of these quantizers is compared with that of the uniform quantizer. IAA

N64-33714 Chalmers U. of Tech., Goteborg (Sweden)
THE ION BEAM ENERGY STABILIZATION SYSTEM OF THE VAN DE GRAAFF GENERATOR AT GOTHENBURG
J. Dubois Scand. U. Books, 1963 20 p refs *Its* Trans. No. 270 Available from Scand. U. Books: 5 SK

A brief description of the construction and performance of the stabilization system is given. Improvements of the inherent voltage stability of the generator are discussed, and a stabilization of the ion beam energy and for the magnetic analyzer system are described, as are the beam energy resolution and the energy calibration. D.E.W.

N64-33718 Mound Lab., Miamisburg, Ohio
HELIUM-3: AN ANNOTATED BIBLIOGRAPHY AEC Research and Development Report
C. F. Eck, K. J. Kaminski, W. A. Wakat, comp., and W. J. Haubach, ed. [1962] 454 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1190) OTS: $5.50

This bibliography contains references with abstracts of articles published before January 1, 1963, which mention helium-3. It is arranged in chronological order by the year of publication of the articles. Each article is numbered serially, thus allowing a visualization of the amount of yearly progress. The bibliography contains both an author and a subject index. D.E.W.

N64-33728 Michigan U., Ann Arbor Electron Physics Lab.
RESEARCH AND DEVELOPMENT ON HIGH-POWER CRESTATRONS FOR THE 100-300 MC FREQUENCY RANGE Quarterly Progress Report No. 16, Apr. 1–Jul. 1, 1964
G. T. Konrad and C. K. Rhee Jul. 1964 39 p ref
(Contract NObsr-81403)
(Rept.-03783; AD-446287)

Trajectory plots for two $P_\mu = 20$ hollow-beam electron guns are shown. A combination of electrostatic and magnetic focusing is employed. The addition of magnetic focusing is shown to simplify the gun geometry and the lens requirements in one case, while in the other case a better behaved beam is obtained. The rf data on an electrostatically focused tube is presented. Even though beam transmission is not ideal either with or without rf drive, it is shown that rf defocusing is not so severe as to limit large-signal operation of the tube. The final design of the magnetically focused 100-W tube is presented. Data on cold tests of the tube and on gun performance are given. Design considerations for the final method of beam focusing are enumerated. Author

N64-33743 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
HANDBOOK FOR THE CALCULATION OF REACTOR PROTECTIONS [FORMULAIRE SUR LE CALCUL DE LA PROTECTION DES REACTEURS]
Nov. 1964 173 p refs Transl. into ENGLISH of the Comm. Energie Atomique rept., prepared by the Eng. of the Serv. for the Study of Reactor Protections, France, 1963 164 p
(CEA-2253; AEC-TR-6349) OTS: $5.00

Subjects covered include the sources of gamma, neutron, and beta radiation, general methods of shielding against gamma radiation and against neutrons, the effects of radiation on shielding materials, radiation leakage in shield vacancies, activation of the coolant fluid, and the shielding of charging–discharging machines. D.E.W.

N64-33755 Naval Air Development Center, Johnsville, Pa. Aeronautical Computer Lab.
COMMENTS ON CORRELATION FUNCTIONS AND POWER SPECTRAL DENSITY FUNCTIONS
E. Toll 18 May 1964 7 p
(NADC-AC-6408; AD-445123)

This report is an elementary introduction into the field of autocorrelation and power spectral density functions. It is written for nonspecialists who desire to gain some understanding of the processes involved and then to make use of the results of such methods of data reduction and analyses. Author

N64-33758 Midwestern Universities Research Assn., Madison, Wis.
NEUTRINO FLUXES WITHOUT FOCUSING AND WITH "IDEAL" FOCUSING
A. I. Galonsky 3 Sep. 1964 17 p
(Contract AT(11-1)-384)
(MURA-698) OTS: $0.50

The problems to be solved in reducing the muon shield thickness are discussed, but no solution is offered. "Ideal" focusing is defined. By direct evaluation it is found that an order-of-magnitude increase in neutrino flux can be obtained with "ideal" focusing as compared with no focusing. This increase is approximately independent of accelerator energy in the range 10 to 1000 BeV. Author

N64-33763* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
INFRARED INDUCED ABSORPTION OF DILUTE SOLUTIONS OF H_2 AND D_2 IN LIQUID ARGON
George E. Ewing and Sandor Trajmar Repr. from J. Chem. Phys., v. 41, no. 3, 1 Aug. 1964 p 814–819 refs
(Contract NAS7-100)
(JPL-TR-32-586)

The induced infrared absorption spectra of dilute solutions of H_2 and D_2 in liquid argon have been studied using a low-temperature cell with a path length of 0.5 m. The close correspondence between observed absorptions with narrow band widths (ν 1/2 $\approx$20 cm^{-1}) and vibration–rotation transitions calculated using the gas-phase molecule spectroscopic constants strongly suggests that H_2 and D_2 rotate freely in liquid argon. An interpretation of the observed broad absorption features (ν 1/2 $\approx$100 cm^{-1}) is considered in which they assigned to vibration–translation combination bands involving changes in translational energy of H_2 (or D_2) in its solvent cage. These translational energy levels shift with isotopic change of the solute. A cell model of the solution system is considered in which the H_2 (or D_2) molecules are assumed to translate in their solvent cages as isotropic harmonic oscillators. The predicted difference in translational energy levels between H_2 and D_2 in argon is in satisfactory agreement with the observed isotopic shifts. Author

N64-33780* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab. Dept.
INTRODUCTION TO NUCLEAR PROPULSION. LECTURE 13: REACTOR CONTROL, APRIL 16–18, 1963
T. A. De Rosier [1963] 50 p refs
(Contract NAS8-5215)
(NASA-CR-52943; GEMP-190h) OTS: $2.00 fs; $0.50 mf

This study indicates methods of control and mechanization and some of the system characteristics required in nuclear reactor control. After a review of previous lectures the following topics are discussed: Definition of Control; Reactor Control Characteristics; Control Processes; and Reactor Nuclear Characteristics Simulation. G.G.

N64-33782* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab.
INTRODUCTION TO NUCLEAR PROPULSION. LECTURES 17 AND 18: MATERIALS FOR NUCLEAR APPLICATION, APRIL 30, MAY 1–2, 1963
J. B. Conway and G. Muehlenkamp [1963] 52 p
(Contract NAS8-5215)
(NASA-CR-52947; GEMP-190I) OTS: $3.00 fs; $0.50 mf

Nuclear propulsion systems for space application are discussed, with particular emphasis on the materials needed for the space systems. The material requirements for the following are considered: (1) fuel elements—fuel material, matrix material, and cladding; (2) moderators and reflectors; (3) control elements; (4) shields; (5) structure; and (6) reactor coolants. P.V.E.

N64-33783* General Electric Co., Cincinnati, Ohio Advanced Technology Services
INTRODUCTION TO NUCLEAR PROPULSION. LECTURES 19 AND 20: RADIATION DAMAGE AND EFFECTS, MAY 7–9, 1963
J. R. Beeler, Jr. [1963] 69 p refs
(Contract NAS8-5215)
(NASA-CR-52949; GEMP-190m) OTS: $3.00 fs; $0.75 mf

Two major classes of radiation-induced changes are discussed: (1) primary effects (radiation damage) produced directly in the initial interaction of radiation, and occurring in the little volume of atomic dimensions; and (2) secondary effects (radiation effects) that arise from interaction of radiation damage products and, for the most part, are changes in the physical properties of the material that can be measured in the macroscopic sense. Radiation damage and effects in organic materials are treated more completely than those in metals, ionic crystals, and semiconductors, because of their pertinence to the Reactor In-Flight Test (RIFT) program. Radiation chemistry and damage processes are discussed for aliphatic and aromatic hydrocarbons and for irradiation effects in polymers. D.S.G.

N64-33787* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ENERGY DEPENDENCE OF LARGE-ANGLE ELASTIC ALPHA SCATTERING FROM Ar^{40}, Ar^{36}, S^{32}, Si^{28}, AND O^{16}
E. T. Boshitz, J. S. Vincent, R. W. Bercaw, and J. R. Priest (Miami U., Oxford) Repr. from Phys. Rev. Letters, v. 13, no. 14, 15 Oct. 1964 3 p refs
(NASA-RP-354)

Large-angle scattering from the even-even nuclei Ar^{40}, Ar^{36}, S^{32}, Si^{28}, and O^{16}, between 30 and 40 MeV, was studied in order to determine whether the phenomena at these angles would exhibit any systematics or whether the effects were peculiar to Ca^{40} and other closed-shell nuclei. It was found that the large-angle elastic alpha scattering cross sections from Ca^{40}, Ar^{36}, S^{32}, Si^{28}, and O^{16} exhibit pronounced diffraction patterns that have a constant angular position as the incident energy is varied between 30 and 40 MeV. Also, Ca^{40}, Ar^{36}, and S^{32} show a strong and systematic energy dependence. From the large difference obtained between Ar^{40} and Ca^{40}, it is suggested that large-angle scattering might be sensitive to some facet of nuclear structure. P.V.E.

N64-33798 Illinois U., Urbana Coordinated Science Lab.
ON CERTAIN RELAXATION OSCILLATIONS: CONFINING REGIONS
Peter James Ponzo and Nelson Wax Jul. 1964 45 p refs
(Contract DA-28-043-AMC-00073(E))
(R-228; AD-603688)

Relaxation oscillations described by the generalized Liénard equation, $\ddot{x} + \mu f(x)\dot{x} + g(x) = 0$ ($\cdot \equiv d/dt$), with $\mu >> 1$, are investigated in the phase and Liénard planes. When f(x), g(x), and $F(x) = \int_0^x f(u)du$ are subject to certain restrictions, a number of analytic curves can be obtained in these planes that serve as bounds on solution trajectories. Piecewise connection of such bounding curves provide explicit annular regions, with the property that solution trajectories on the boundary of an annulus move to the interior with increasing time, t. The Poincaré–Bendixson theorem then guarantees at least one periodic orbit within such an annulus. It is shown that the periodic orbits that are isolated by this means are unique within the annulus, hence orbitally stable. The maximum width of the annulus is of order $\mu^{-4/3}$, and the amplitude bounds obtained for the periodic solution agree favorably with the known amplitude for the specific case of the van der Pol equation $\ddot{x} + \mu(x^2 - 1)\dot{x} + x = 0$. The results are generalized to less restrictive f(x), g(x), and F(x) than those first considered. Author

N64-33803* Chicago U., Ill. Inst. For The Study of Metals
COHERENT PAIRING OF THE SECOND KIND FOR STRONGLY INTERACTING FERMIONS
Morrel H. Cohen Repr. from Phys. Rev. Letters, v. 12, no. 24, 15 Jun. 1964 p 664–666 refs
(Grant NsG-352)

Possible radial dependences of the s-wave singlet pairing alternatives to those in superconductors are proposed. The proposed possibility is strengthened by a rigorous solution of the BCS integral equation for a general interaction as well as in weak pairing. A denumerable infinite set of potential solutions was found. Only one of these solutions corresponds to the BCS superconducting state. If the BCS super-conducting state is one with coherent pairing of the first kind (CPI), the new states may then be called states with coherent pairing of the second kind (CPII). A mixed superconducting state with both CPI and CPII can also occur; above the superconducting transition temperature, only the CPII would remain. It is also shown that excited states characterized by the propagation of a real p-wave singlet pair can occur in both normal metals and metals having CPII. P.V.E.

N64-33814 Chalmers U. of Tech., Goteborg (Sweden)
LOW ENERGY EXCITED LEVELS IN SOME VANADIUM ISOTOPES
J. Dubois 1963 34 p refs Scand. U. Books, 1963 34 p refs *Its* Transl. No. 269 Available from Scand. U. Books: 8 SK

Low-energy gamma rays from proton capture in the stable isotopes of titanium have been measured. In order to decrease the X-ray background, the targets used have been prepared on thin carbon foils by electromagnetic isotope separation. New levels at 420 and 605 keV in V^{48} and at 324 and 900 keV in V^{50} were found. Branching ratios of the low excited levels have been determined. Author

N64-33826 Army Chemical Center, Edgewood, Md. Nuclear Testing Div.
NEUTRON-FLUX AND GAMMA-DOSE MEASUREMENTS AT THE AFRRI REACTOR
John R. Jacobson, David T. Kilminster, John H. McNeilly, and Robert J. Smith Sep. 1963 82 p refs
(NDL-TR-59; AD-442884)

The neutron threshold-detector system was used to measure the neutron environment of the reactor. Gamma dosimetry for the facility was accomplished by use of film dosimeters, silver-activated phosphate glass rods, and cobalt-activated

borosilicate glass plates. A total of 1543 neutron-flux measurements and 437 gamma-dose measurements was made during the course of the experimental program. The results of neutron-flux measurements in the thermal neutron exposure room indicate a thermal neutron flux ($E_n < 0.3$ eV) approximately 2×10^3 times greater than the flux of fast neutrons with energies above 1.5 keV. Author

N64-33831 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering

NUMERICAL SOLUTION OF THE PERTURBED HARMONIC OSCILLATOR EQUATION AND THE HARTREE-FOCK MANY-ELECTRON EQUATIONS BY USE OF GREEN'S FUNCTION

Donald Richard Lehman (M.S. Thesis) Aug. 1964 97 p refs
(GSP/Phys/64-9; AD-603607)

The use of Green's Function to numerically solve the perturbed harmonic oscillator equation and the Hartree–Fock many-electron atom equations for H^-, He, and Be are developed. The use of Green's Function is demonstrated to be a powerful method of solving these equations. The given quantum mechanical differential equations are transformed into an integral equation by means of Green's Function. The boundary conditions of the physical problem are built into the integral equation by the Green's Function, and need not be forced during the iteration scheme. The choice of the homogeneous equation to determine the Green's Function is not arbitrary when the potential function is unbounded, e.g., in the oscillator problem. The general method of solution of the integral equation, the iterative procedure, is very easy to code for computation on a digital computer. P.V.E.

N64-33840 New York U., N.Y.

MEASUREMENT OF THE EFFECTIVE ELECTRIC POLARIZABILITIES OF $^3P_2$ METASTABLE ARGON IN SELECTED MAGNETIC SUBSTATES

Edward Pollack, Edward J. Robinson, and Benjamin Bederson [1963] 48 p refs Submitted for Publication
(Contract Nonr-285(15); Grant DA-ARO-(D)-31-124-G269)
(AD-424089)

The atomic beam E-H gradient balance method has been employed to measure the z-component of the electric polarizability tensors, $\alpha_z(m_J)$, of the $m_J = +2$ and $m_J = +1$ magnetic substates of $^3P_2$ metastable argon. The measurements were normalized to the polarizability of $^3S_1$ metastable helium, which is calculable to within an accuracy of 1%. In this method, a metastable beam is passed through a region containing transverse, congruent, inhomogeneous electric and magnetic fields. The condition that atoms in a particular magnetic substate experience no deflection in such a field region is $\alpha_z(m_J)E(\delta E/\delta z) = \mu_{eff}(\delta H/\delta z)$, where μ_{eff} is the effective magnetic moment in the field H, and $\delta E/\delta z$ and $\delta H/\delta z$ are the z-components of the gradients of the magnitudes of the electric and magnetic fields, respectively. Author

N64-33846 Lockheed Missiles and Space Co., Sunnyvale, Calif.

EXAMINATION OF THE TWO-STREAM APPROXIMATION FOR RADIATIVE TRANSFER THROUGH SPHERICALLY SYMMETRIC MEDIA

D. S. Carter Aug. 1963 40 p refs *Its* Rept. 3-27-63-2
(Contract DASA-49-146-XZ-198)
(DASA-1486; AD-446512)

A computer code developed for calculations of the growth of nuclear fireballs and related applications makes use of the two-stream approximation in treating the radiative transport of energy. This method was originally developed for the solution of problems in plane geometry. In this report, application of the method to the case of spherical symmetry is discussed. The transmission of a zone is calculated under the assumption that the radiation incident on the zone is isotropic. Comparison of the transmission coefficients derived in this way to the corresponding two-stream coefficients leads to suggestions for modifications to permit application of the two-stream approximation to spherical problems. Author

N64-33865 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio

NUCLEAR CRITICALITY CALCULATIONS ON A SPHERICALLY SYMMETRIC GASEOUS-CORE REACTOR

John Richard Rec May 1964 107 p refs
(GNE/Phys-64-14; AD-603614)

Nuclear criticality calculations are performed on a two-region, spherically symmetric gaseous-core reactor. The core is fueled with U^{235} vapor and is externally moderated by various thicknesses of graphite at 4000° K. A one-group (thermal) transport analysis with a fast effect correction, which accounts for above-thermal fissions and absorptions, is used to perform the criticality calculations. The approximate multigroup transport analysis predicts critical radii that are smaller in all cases than the critical radii predicted by the multigroup transport analysis. The rather large differences in the predicted critical radii are thought to result from the interface boundary condition imposed on the age-diffusion equation, which is used to calculate the fast effect correction. D.E.W.

N64-33883 Brown U., Providence, R.I. Div. of Applied Mathematics

THE MECHANICS OF MATERIALS WITH STRUCTURE Technical Report No. 94

A. E. Green and R. S. Rivlin Jul. 1964 17 p refs
(Contract Nonr-562(10))
(C11-94; AD-603568)

It is the object of this paper to show the manner in which methods of classical continuum mechanics may be extended to apply to the physical system of a solid matrix in which solid particles with different mechanical properties are distributed in a random manner. A force system is applied to the body, and a vector displacement field results. Deformation by tensor fields of various orders is described, and the associated forces as the coefficients of these tensors in a work formula are defined. D.S.G.

N64-33884 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering

A METHOD FOR GENERATING A CYLINDRICAL HOMOGENEOUS MAGNETIC FIELD VOLUME

David E. Mc Intyre (M.S. Thesis) Jun. 1964 67 p refs
(GSP/Phys-64-10; AD-603616)

This paper discusses the synthesis of a uniform magnetic field along the axis of a system of coaxial coils and solenoids. Both ideal (thin) and real (thick) sources are treated. A field of specified constant intensity throughout some system length is synthesized by varying the turn density on solenoids and the position of Helmholtz-like coils subject to constraints imposed by access spaces. Given the axial field to be generated and the interval that is to be accessible, an integral equation is derived that the turn density must satisfy. The integral equation is a Fredholm equation of the first kind. Author

N64-33895 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)

MUON COUPLING PARAMETERS FROM RADIATIVE MUON ABSORPTION IN LIQUID HYDROGEN

E. Borchi and R. Gatto 10 Jun. 1964 8 p refs *Its* Nota Interna No. 246
(LNF-64/26)

Radiative muon absorption in liquid hydrogen is discussed, including a possible term in the axial current with second-class behavior under G-transformation. The conserved vector-current hypothesis, recently confirmed by experiment, implies that the vector current has first-class behavior under G. Calculations are made for the V-A theory with conserved vector current. Exactly the same model is used here as was used in a previous paper in a discussion of the radiative process in nuclei. Tables give the calculated ordinary and radiative absorption rates in liquid hydrogen. D.E.W.

N64-33900 Oak Ridge National Lab., Tenn. Neutron Physics Div.
PROGRAM STATEST, AN APPLICATION OF THE METHOD OF STATISTICAL ESTIMATION TO THE CALCULATION OF NEUTRON FLUX IN ANISOTROPICALLY SCATTERING MEDIA BY MONTE CARLO
W. E. Kinney Nov. 1964 31 p refs
(Contract W-7405-ENG-26)
(ORNL-3715)

FORTRAN programs to estimate the neutron flux in as many as 50 energy groups and at up to 10 detector locations or field points in systems composed of not more than two media have been written for the CD-1604A and IBM-7090 computers. Each medium may contain as many as 10 scatterers; the total number of anisotropic scatterers in the system, however, is limited to three in the codes as presented. The programs utilize the method of statistical estimation to analyze neutron collisions generated by the Monte Carlo neutron transport code 05R. A P_8 approximation is used for the expansion in Legendre polynomials of the angular distribution of anisotropically scattered neutrons. FORTRAN listings of both versions of the code are presented, along with listings of two subroutines called by the CD-1604A version. Author

N64-33904* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TWO-CENTER COULOMB INTEGRALS
Murray Geller 1 Oct. 1964 23 p refs
(Contract NAS7-100)
(NASA-CR-59382; JPL-TR-32-673) OTS: $1.00 fs; $0.50 mf

One of the difficulties in the application of nonrelativistic quantum mechanics to molecular systems has been the evaluation of the integrals that arise from the use of trial wavefunctions. The present investigation is concerned with a derivation and expression for the general two-center Coulomb integral (over Slater-type atomic orbitals), based on the Fourier-convolution method. All of the Coulomb integrals through N = 4 are given in explicit form in terms of an auxiliary function $W^{p,q}_{m,n}$ which is a simple one-dimensional integral. Author

N64-33923* Uppsala U. (Sweden)
HIGHLY IONIZED SPECTRA OF NITROGEN AND OXYGEN
Status Report No. 2, 1 Mar.–31 May 1964
Kjell Bockasten, J. Bromander, R. Hallin, and B. Johansson [1964] 3 p
(Contract NASr-174)
(NASA-CR-59379) OTS: $1.00 fs; $0.50 mf

A system of wavelength standards is reported for the region 6500 to 8500Å, using A I and Ne I lines, as recommended by the IAU. In the region 2890 to 5200Å a set of A II lines was used. Below 2000 Å a number of lines have been used, and in the region 1600 to 3000 Å the wavelengths of Hg I, Hg II, Ne I, and Ne II were published. Work on the lines from N V in the vacuum ultraviolet is reported. D.E.W.

N64-33930 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
PROPAGATION OF ACOUSTIC-GRAVITY WAVES IN A TEMPERATURE- AND WIND-STRATIFIED ATMOSPHERE
Scientific Report No. 2
Allan D. Pierce 28 Aug. 1964
(Contract AF 19(628)-3891)
(RAD-TR-64-33; AFCRL-64-711; AD-607242)

A theory is presented that permits the study of the effects of horizontal winds on the dispersion and amplitudes of acoustic-gravity waves in the atmosphere. It is shown that the effective horizontal group velocity for a given frequency in a given normal mode depends on direction of propagation as well as on frequency and that it is not necessarily in the same direction as the horizontal wave number vector. A number of useful integral theorems are derived from a variational principle, and one is subsequently applied to the development of a perturbation method for the computation of wind effects on dispersion. Application of the method to a realistic example indicates that winds can appreciably alter the dispersion of the normal modes and that they should be considered in any quantitative interpretation of experimental microbarograms. Author

N64-33934 Aerospace Corp., El Segundo, Calif. Electronics Div.
GENERAL EQUATIONS OF MOTION FOR A GRAVITATIONALLY ORIENTED MULTIPLE-PART SATELLITE
V. Chobotov 21 Sep. 1964 49 p refs
(Contract AF 04(695)-269)
(TDR-269(4540-70)-8; SSD-TDR-64-163; AD-607216)

The general equations of motion for a multiple-part satellite are presented. These equations are then specialized for a two-body satellite that has energy dissipation, which is subject to gravitational and other forces. By use of Euler angles and Euler parameters for various coordinate transformations, the scalar forms of the equations are derived. Methods for possible solution of the equations are discussed. Author

N64-33941 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INCREASE IN THE RATE OF CONDENSATION IN AN ELECTRIC FIELD IN PRESENCE OF IONS
A. K. Zhebrovskiy 22 Sep. 1964 7 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 2, 1964 p 21-24
(FTD-TT-64-548/1+2; AD-607302)

Described are experiments on the condensation of water vapors into solid state upon introduction of ions into the condenser with simultaneous imposition of an electric field. The rate of condensation depends upon the pressure of the noncondensing gas, intensity of the electric field, and the amperage in the discharge. Author

N64-33946 Illinois U., Urbana
THERMAL ELECTRIFICATION OF A CONDUCTING SPHERE
R. C. Dimick and S. L. Soo Aug. 1964 11 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(ILL-15-p; AD-445932)

Charging of a conducting sphere enclosed in a concentric vacuum by thermionic emission as limited by space charge was studied. A method of solution of the integral equation of the electric field is presented. Author

N64-33954 Battelle Memorial Inst., Columbus, Ohio
STOPPING BY ELASTIC COLLISIONS OF PARTICLES FROM A UNIDIRECTIONAL PLANE SOURCE

E. M. Baroody Wright-Patterson AFB, Ohio, ARL Aug. 1964 49 p refs
(Contract AF 33(657)-8853)
(ARL-64-129; AD-430882) OTS: $1.25

Calculations are made of certain averages for particles from a plane, unidirectional source being slowed down by elastic collisions in an infinite medium of randomly located target atoms. Calculations are based on the moments form of the Boltzmann transport equation and follow procedures frequently used in the theory of neutron moderation. Assuming isotropic scattering in the center of mass coordinates, averages are determined for powers of the distance from the source and for Legendre polynomials, which give information on the direction of motion. When the mean free path varies as a power of the energy a number of averages are determined at all energies for equal masses of fast particles and target atoms, and for the first collision interval for unequal masses. Expressions for spatial averages at zero energy are obtained by taking the Laplace transform of the moments equation. Author

N64-33962 Argonne National Lab., Ill. Biological and Medical Research Div.
RECENT DEVELOPMENTS IN THE THEORY OF NEUTRON CAPTURE THERAPY (JANUARY 1958) AND SYSTEMS FOR NEUTRON CAPTURE THERAPY: GENERAL CONSIDERATIONS (OCTOBER 1959)
Norman A. Frigerio Jun. 1964 42 p refs
(Contract W-31-109-ENG-38)
(ANL-6910) OTS: $1.00

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1. RECENT DEVELOPMENTS IN THE THEORY OF NEUTRON CAPTURE THERAPY Norman A. Frigerio p 1–19 refs

2. SYSTEMS FOR NEUTRON CAPTURE THERAPY: GENERAL CONSIDERATIONS Norman A. Frigerio p 20–42 refs

N64-33964 Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
A LINEAR LEAST-SQUARES FITTING PROGRAM FOR THE ANALYSIS OF GAMMA-RAY SPECTRA INCLUDING A GAIN-SHIFT ROUTINE
R. G. Helmer, D. D. Metcalf, R. L. Heath, and G. A. Cazier Sep. 1964 59 p refs
(Contract AT(10-1)-205)
(IDO-17015) OTS: $1.25

A computer program is described that is intended for use in the analysis of complex gamma-ray spectra obtained with scintillation spectrometers. Given a composite spectrum and a set of up to 25 component spectra, the program determines the intensities of these components in the composite by carrying out a linear, least-squares fit. Several options are available to adapt the program to spectral analysis. These include the ability to subtract backgrounds, fix the intensities of selected components, fix the relative intensity of any two components, reject negative intensities, vary the number of data points used in the electronic system, the gain of the spectra may be changed by a gain-shift subroutine. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-32774* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ION AND PLASMA TECHNOLOGY
Warren D. Rayle *In its* Conf. on New Technol. 1964 p 113–118 (See N64-32767 24-01) GPO: $1.00

Accomplishments and objectives in ion and plasma technology are reviewed, particularly as they apply to space propulsion, power generation, and nuclear fusion. Although such the abilities to produce and use very energetic streams of matter and to heat appreciable quantities of matter to extreme temperatures are being acquired. M.P.G.

N64-32854 Princeton U., N.J. Plasma Physics Lab.
HYDROMAGNETIC INSTABILITY IN A STELLARATOR
R. M. Sinclair, S. Yoshikawa, W. L. Harries, K. M. Young, K. E. Weimer et al Apr. 1964 70 p refs
(Contract AT(30-1)-1238)
(MATT-262)

Stability diagrams are calculated for hydromagnetic kink instabilities in a zero-pressure plasma confined in a stellarator geometry with arbitrary mixtures of $l = 2$ and $l = 3$ multipolar helical fields and with various radial distributions of the current parallel to the confining magnetic field. The introduction of small pressure gradients increases the size of the unstable regions. Modes with small azimuthal wave number grow more rapidly than those with large m. Experimental data, obtained with the Model C Stellarator, show that the plasma is macroscopically stable except for certain intervals of rotational transform. These intervals agree qualitatively with those in which the theory predicts the plasma to be unstable against the kink instability. Author

N64-32867 Stanford U., Calif.
DIRECT ENERGY CONVERSION SYSTEMS Semiannual Technical Summary Report No. 3, 1 Oct. 1962–1 Apr. 1963
Charles H. Kruger 30 Apr. 1963 54 p refs
(Contract AF 49(638)-1123; ARPA Order 246-62)
(AD-406355)

This research effort encompasses studies of magnetogasdynamics, fuel cells, and thermoelectric energy conversion. Author

N64-32963 Stanford U., Calif.
DIRECT ENERGY CONVERSION SYSTEMS Semiannual Technical Summary Report, 1 Apr.–1 Oct. 1963
Robert H. Eustis 20 Oct. 1963 129 p refs
(Contract AF 49(638)-1123; ARPA Order 246-62)
(AD-423164)

Studies are reported in magnetogasdynamic, fuel cell, and thermoelectric energy conversion. Development of a magnetogasdynamic continuous flow channel and the theoretical work done on heat transfer and fluid friction in MGD generators are described. An optical study was made of the mode in which shock-heated argon approaches ionization equilibrium. Transport properties of partially ionized argon were analyzed. Fuel cell studies involved electrode catalysis in hydrocarbon systems, with particular emphasis on the role of solid-state properties on the electrode reaction. Techniques and instrumentation were developed to measure thermal diffusivity, Seebeck coefficient, and electrical resistivity from room temperatures to about 1000° C. The data observed on the semiconductor lead telluride is presented. Basic materials research was done on the phase relations and electrical properties of silver antimony telluride. R.L.K.

N64-32964 Stanford U., Calif.
DIRECT ENERGY CONVERSION SYSTEMS Quarterly Technical Summary Report, 1 Oct.–30 Nov. 1963
Robert H. Eustis 30 Dec. 1963 26 p refs
(Contract AF 49(638)-1123; ARPA Order 246)
(AD-430023)

Three power generating runs were made with the MGD generator in which electrical characteristics for segmented operation were determined and electrode materials were evaluated. Power generated at 13 pairs of electrodes exceeded 2 kW. The open-circuit voltage was about 115 V, and short-circuit current about 5 A. Plasma-sprayed coatings on the graphite electrodes significantly increased the electrode life. Molybdenum disilicide was the most effective coating material tested. Shock tube measurements of ionization rates in argon continued with improved results from a rotating mirror camera technique. A study was made of the kinetics of oxidation of aliphatic and olefinic hydrocarbons on single doped and undoped crystal platinum in $HClO_4$ electrolyte using a translating crystal electrode. Also static measurements to determine the kinetics of formic acid oxidation were made. Author

N64-33055 Nagoya U. (Japan) Inst. of Plasma Physics
PARTICLE ORBITS IN A HELIOTRON MAGNETIC FIELD
Tsuneo Amano, Masanori Murakami, and Akizi Outi Jul. [1964] 36 p refs
(IPPJ-21)

Numerical orbit integrations of charged particles in an axisymmetric heliotron magnetic field were carried out on an electronic computer. From the results of calculations, several characteristics of particle orbits, the adiabaticity of magnetic moment, and azimuthal drifts of particles are examined.
Author

N64-33151* Stanford U., Calif.
LANGMUIR PROBE RESPONSE TO PERIODIC WAVEFORMS
F. W. Crawford and R. F. Mlodnosky Repr. from J. Geophys. Res., v. 69, no. 13, 1 Jul. 1964 p 2765–2773 refs
(Grant NsG-174-61; Contract AT(04-3)-326)

Various ways in which the response of Langmuir probes to periodic waveforms can be interpreted to yield information either on laboratory plasmas or on charged particles in space are discussed. Progress made in this field of plasma diagnostics is surveyed, and an analysis is presented of a new ac method of determining electron density and temperature. The new method depends on the measurement of probe admittance and should have useful applications to ionospheric probing by rockets and satellites. Details of an illustrative example are given. Some of the implications of the theory presented bear on the accuracy of probe measurements of electron velocity distributions made by second-derivative methods. These errors are discussed briefly. IAA

N64-33202* General Motors Corp., Indianapolis, Ind. Allison Div.
SPECTROSCOPIC INVESTIGATIONS OF PLASMA PROPERTIES Quarterly Summary Report No. 1, 11 May–10 Aug. 1964
R. T. Schneider and F. G. Myers 9 Sep. 1964 29 p *Its* Rept.-3969
(Contract NASw-922)
(NASA-CR-58969) OTS: $2.00 fs; $0.50 mf

A new spectroscopic method was conceived that allows temperature or pressure measurement in low-temperature plasmas. The fundamental theory, upon which the method is based, was developed. For the case of seeded plasmas, the method could be modified to further increase the exactness. To test this spectroscopic technique, a plasma source permitting adjustment of electron density and temperature was designed and constructed. Preliminary experiments showed that the source performs satisfactorily. Author

N64-33236 Argonne National Lab., Ill. Reactor Engineering Div.
PERFORMANCE CHARACTERISTICS OF A LIQUID METAL MHD GENERATOR
Michael Petrick and Kung-You Lee Jul. 1964 71 p refs
(Contract W-31-109-ENG-38)
(ANL-6870) OTS: $3.00

An experimental study was made of the performance characteristics of a liquid metal MHD generator utilizing single-phase NaK and two-phase NaK-N_2 fluids. The purpose of this study was to compare the generator performance with theory for single-phase flow and to determine the effects of the introduction of the gaseous phase on the generator output and efficiency. Data were taken over the following parameter ranges: fluid velocity, 1.11 to 10.94 ft/sec; mixture quality, 0 to 0.0156; volumetric void fraction, 0 to 0.66. The variation of the Hartmann number and the magnetic Reynolds number (based on the height of the channel) corresponding to these parameter ranges was 88 to 178, and 0.035 to 0.35, respectively. Author

N64-33242 General Electric Co., Schenectady, N.Y.
MILLIMETER WAVE GENERATION BY PLASMA Interim Engineering Report, 30 Jun.–30 Sep. 1963
7 Oct. 1963 13 p refs
(Contract NObsr-89507)
(AD-422362)

This engineering report describes the millimeter wave generation program experimental setup as it has evolved to date. The experimental tube will be made in two sections. One section will contain the electron emitter, the accelerating structure, and the traveling-wave-tube helix. The second section will contain any of three different electrode arrangements for generating a highly ionized plasma in the interaction zone and a TM01 horn for coupling the transverse electromagnetic wave out of the plasma into space. The entire experimental tube will be located within a solenoid capable of producing a pulsed flux density of 30 kg. An available 125 kilojoule capacitor bank and switch tubes will be used as the driving source for the solenoid. External load coils and resistors will be used to obtain critically damped rise times from 500μsec to 3 msec.
Author

N64-33305 Michigan U., Ann Arbor Radiation Lab.
A STUDY OF PLASMA APPLICATIONS IN MICROWAVE CIRCUITS—II Final Report
A. Olte and E. K. Miller Griffiss AFB, N.Y., RADC, Aug. 1964 89 p refs *Its* Rept.-4915-2-F
(Contract AF 30(602)-2605)
(RADC-TDR-64-244; AD-606871)

This report contains the development of a first-order theory for calculating the absorption in the electron cyclotron resonance isolator and its equivalent circuit. Two theoretical models are used to describe the plasma–electromagnetic wave interaction and are found to produce equivalent results for the range of variables investigated. A comparison of theoretical and experimental results shows the theory to be reasonable when the assumptions that are made in its development are satisfied by the experimental conditions. The experimental work on a rectangular plasma package is described. Hydrogen and xenon

gases are used in hot cathode discharges to produce a plasma, and plasma frequencies of more than 10 Gc are obtained.
Author

N64-33378* Consultants and Designers, Inc., Arlington, Va.
ENERGY SPECTRA OF A PLASMA INTERACTING WITH A TRANSVERSE MAGNETIC FIELD [ENERGETICHESKIYE SPEKTRY PLASMY, VZAIMODEYSTVUYUSHCHEY S POPERECHNYM MAGNITNYM POLEM]
I. I. Demidenko, V. G. Padalka, B. G. Safronov, and K. D. Sinel'nikov 12 Oct. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 157, no. 6, 1964 p 1335–1337
(Contract NAS5-3760)
(NASA-TT-F-8970; ST-PP-10219) OTS: $1.00 fs; $0.50 mf

The measurement of plasma flow velocities by electric probes showed that when the plasma passes through the transverse field, its mean propagation velocity decreases, whereas the mean velocity of plasma motion in a magnetic field is greater than the velocity created by the injector. The plasma cluster interaction with the transverse magnetic field was studied, and results indicate that the generation of clusters takes place in a comparatively small interval at the beginning of the first half period of the discharge current. The spectral investigation of plasma ions created by the source showed the presence of hydrogen, carbon, aluminum, and iron ions. The energy spectra of hydrogen, carbon, and aluminum ions in the plasma are displayed graphically. D.E.W.

N64-33380* Consultants and Designers, Inc., Arlington, Va.
STATIONARY ROTATION OF A RAREFIED GAS MASS GRAVITATING IN A MAGNETIC FIELD [STATSIONARNOYE DVIZHENIYE RAZREZHENNOY GRAVITIRUYUSHCHEY GAZOVOY MASSY V MAGNITNOM POLE]
M. K. Zhekamukhov 14 Oct. 1964 10 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 4, 1964 p 23–28
(Contract NAS5-3760)
(NASA-TT-F-8972; ST-GD-10221) OTS: $1.00 fs; $0.50 mf

The rotation of a rarefied, gravitating gas mass in a magnetic field is considered without taking into account the pressure forces. The solution of gas-dynamics equations, taking into account the finite conductivity of the medium, are obtained for three cases, when the magnetic field vectors have, in the cylindrical system of coordinates, the form $\vec{H}(H_r, H_\varphi, 0)$, $\vec{H}(0, 0, H_z)$, $\vec{H}(0, H_\varphi, 0)$. Considered also are the particular cases of rotation, taking into account the forces of pressure. Author

N64-33387* Consultants and Designers, Inc., Arlington, Va.
DETERMINATION OF CAESIUM GAS DISCHARGE PLASMA PARAMETERS BY MICROWAVE METHOD [OPREDELENIYE PARAMETROV GAZORAZRYADNOY TSEZIYEVOY PLAZMY SVERKHVYSOKOCHASTOTNYMI METODAMI]
N. D. Morgulis, S. M. Levitskiy, and V. A. Panichevskiy 28 Oct. 1964 13 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 8, 1964 p 1433–1439
(Contract NAS5-3760)
(NASA-TT-F-8980; ST-PP-10231) OTS: $1.00 fs; $0.50 mf

A determination is made of electron collision frequency and of the rate of decay of a feebly ionized cesium plasma by a microwave method in the 3-cm waveband. The range of charge concentration was of the order of 10^{11} to 10^{12} cm^{-3}, and that of cesium vapor pressure was 0.01 to 02 (0.5) mm. Hg. An estimate is made, on the basis of the results obtained, of the value of the effective diameter of electron scattering by cesium plasma atoms and of the bipolar diffusion coefficient. Comparision is made between the results obtained here and those of other authors. Author

N64-33444 Yale U. Observatory, New Haven, Conn.
COULOMB INTERACTIONS IN A STRONG MAGNETIC FIELD
Robert Goldman and Ludwig Oster Wright-Patterson AFB, Ohio, ARL, May 1963 125 p refs
(Contract AF 33(616)-7271)
(ARL-63-90; AD-412506)

From the adiabatic spectral line theory of Lindholm and the generalized quantum treatment of pressure effects by Anderson, an expression is derived for the emission spectrum of cyclotron radiation from free charged particles in typical plasma situations. After adapting the formalism to account for the continuous nature of the energy states parallel to the magnetic field, and after including the energy dependence of the dipole matrix element, shift and half-width values are obtained for the cyclotron line in the case of a strong magnetic field. Extension to the weak field case can then be made in a plausible manner, resulting in the ordinary Coulomb cross section for vanishing magnetic field strength. Using these cross sections, the conductivity tensor due to Coulomb interactions in a strong magnetic field is calculated. Author

N64-33448 General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
INVESTIGATION OF PRECURSOR IONIZATION IN FRONT OF THE SHOCK WAVES OF HYPERSONIC PROJECTILES
Srbislav Zivanovic Sep. 1963 32 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 347-63; Proj. Defender)
(TR63-217E; AD-423930)

An experimental attempt has been made to measure the precursor electron density as a function of distance ahead of the shock front of hypersonic projectiles in a ballistic range. The electron density just preceding the shock front has been measured as a function of projectile velocity and of ambient pressure. For velocities up to 6700 m/sec and pressures up to 30-mm Hg the measured density of electrons in the vicinity of the shock front is of the order of 10^9 e/cm^3. The maximum electron density of the precursor ionization increases almost exponentially with velocity. At a fixed pressure, the electron density increases about 30 times for an increase of velocity from 5300 to 6700 m/sec (18 000 to 22 000 fps). The electron density also increases with pressure, but this variation is not so explicit. An additional experiment has shown that, at least in the considered region of velocities from 5300 to 6700 m/sec, photoionization is the dominant mechanism and electron diffusion plays only a secondary role. Author

N64-33465 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
RATES OF IONIZATION AND RECOMBINATION PROCESSES IN HEATED AIR
James H. Renken Jul. 1964 38 p refs Sponsored by DASA
(TR-3153; AD-444343)

The procedures used to calculate rate constants for certain ionization and recombination reactions are described. Results of calculations based upon these procedures and analytical expressions that approximate the values found with the computer are presented. The only recombination reactions treated are those yielding a hydrogenic ion. Extension of the present formalism to cases where multielectron ions are formed is restricted primarily by the lack of convenient radiative transition-rate information for multielectron systems. Author

N64-33491 Johns Hopkins U., Baltimore, Md.
MAGNETOHYDRODYNAMIC AND PLASMA TURBULENCE
Leslie S. G. Kovasznay Sep. 1964 25 p refs Presented at the 11th Intern. Congr. of Appl. Mech., Munich, 30 Aug.–5 Sep. 1964
(Contract Nonr-3623(00); Proj. Squid)
(JHU-23-P; AD-606395)

A review of the development in turbulence of electrically conducting media is given for the last 4 to 5 years. Theories of homogeneous turbulence both "passive" and "active" are summarized. The "chemical" approach in hot wakes is also reviewed. The possibility of electrostatic turbulence completes the review. Author

N64-33493 Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
SCATTERING OF ELECTROMAGNETIC WAVES FROM THE DISTURBANCE CAUSED BY A RAPIDLY MOVING BODY IN PLASMAS
S. K. Suh Aug. 1964 29 p refs
(Contract DA-01-021-AMC-85(Z))
(R-111; AD-606290)

General theory covering scattering phenomena is developed with emphasis on a perturbation method. The theory is extended to investigate the scattering of electromagnetic waves from the disturbance caused by a rapidly moving body in the ionosphere, and the scattering of electromagnetic waves from the turbulent wake produced by a reentry vehicle. In the first problem, kinetic equations are used to find the frequency spectrum of the electron density fluctuations in terms of which the differential scattering cross section can be expressed. The differential scattering cross section is obtained in terms of the correlation function for turbulence, which can be estimated by using the correlation length. Author

N64-33498 Nagoya U. (Japan)
THE EFFECT OF FINITE ION LARMOR RADIUS ON THE ALFVEN WAVE INSTABILITY
Nobuo Yajima and Tosiya Taniuti Jul. 1964 8 p refs
(IPPJ-28)

According to the Chew–Goldberger–Low(CGL) approximation, the phase velocity of the Alfven wave propagating along an unperturbed magnetic field in a plasma with an anisotropic pressure given by

$$V_A^2 = B^2/(4\pi\rho) + P_\perp/\rho - P_\parallel/\rho$$

where B, ρ, $P_\perp$, and $P_\parallel$ are the magnetic flux, the mass density, and the normal and longitudinal components of pressure, respectively. When $P_\parallel$ exceeds a critical value, V_A^2 becomes negative—the so-called Alfven instability. This paper discusses the effect of finite Larmor radius on the Alfven instability and shows that the Alfven mode is stabilized by the finiteness of the Larmor radius. Author

N64-33564* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STABILITY OF HARD-CORE PINCH WITH ANISOTROPIC PLASMA PRESSURE
S. P. Talwar and J. N. Tandon (Delhi U.) Aug. 1964 34 p refs
(NASA-TM-X-55091; X-640-64-238) OTS: $2.00 fs; $0.50 mf

This is a study of a hard-core pinch device consisting of an annular plasma detached from the central core and from the surrounding conducting wall by opposite axial currents flowing in the core and the plasma. The instability of the configuration was investigated, with the emphasis on the plasma pressure being anisotropic rather than scalar. This occurs in a dilute plasma subjected to a high magnetic field. The usual normal-mode technique is applied, and a dispersion formula is obtained with the "double-adiabatic" hydromagnetic equations and is discussed for marginal stability for axisymmetric perturbations. G.G.

N64-33565* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPAGATION OF HYDROMAGNETIC WAVES IN THE MAGNETOSPHERE
Masahisa Sugiura Aug. 1964 65 p refs Presented at the Symp. on Ultra Low Freq. Electromagnetic Fields (from 30 c/s to 0.001 c/s), Boulder, Colo., 17–20 Aug. 1964
(NASA-TM-X-55092; X-612-64-240) OTS: $3.00 fs; $0.75 mf

The equations of motion for an electromagnetic ray are derived. Defining the action for the ray in analogy with that for a particle in classical mechanics, the principle of least action is proved. If the dispersion relation is homogeneous in the wave vector and the frequency, the principle of least action implies the principle of least time, i.e., Fermat's principle. When the principle of least time holds, as is the case with Alfven compressional waves, the trajectory of a ray can be determined from a variational equation, from which the problem can be formulated in Hamiltonian form. This method is applied to a model magnetosphere with a dipole magnetic field. It is shown that the accessibility of hydromagnetic rays originating from the boundary of the magnetosphere to the earth is greatly limited. Typical ray trajectories in the equatorial plane are shown. Author

N64-33595 Ohio State U. Research Foundation, Columbus Antenna Lab.
SOME MAGNETO-IONIC NOMOGRAPHS
R. J. Plugge 15 May 1964 18 p refs
(Contract AF 33(657)-10426)
(Rept.-1565-11; AD-445858)

Nomographs are presented that will enable construction of the components of the complex relative permittivity eigenvalues for a magnetoionic medium with the complete range of the normalized parameters (X,Y,Z) of the medium. An additional nomograph then relates the components of the complex relative permittivity to those of the complex index of refraction of the medium. Author

N64-33600 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
A CONSTANT CURRENT SHEET VELOCITY MODEL OF THE COAXIAL PLASMA ACCELERATOR
F. W. Mezger Aug. 1964 28 p refs
(R64SD61; AD-445138)

A one-dimensional macroscopic theory for coaxial electrode plasma accelerators is considered. The basic generic equations for such theories are derived from fundamental principles. In view of recent experience with efficient plasma accelerators indicating that they have a nearly constant current sheet velocity, the equations of motion for the case of a constant current sheet velocity are solved in closed form. Formulas for calculating energy and thrust efficiencies and specific impulse are given. Since no explicit formula for calculating the current sheet velocity is presented, the primary value of this theory is to serve as a basis for correlating and understanding experimental results. Possible extensions of the present theory are discussed briefly. Author

N64-33632* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INTENSIFICATION OF MAGNETIC FIELDS IN PLASMAS
R. K. Jaggi Jul. 1964 28 p refs
(NASA-TM-X-55076; X-640-64-177) OTS: $1.00 fs; $0.50 mf
mf

Magnetohydrodynamic equations are used to obtain the solution to the problem of intensification of the magnetic field in an infinite plasma containing a uniform magnetic field by a motion of the semi-infinite plasma perpendicular to the field. Self-consistent solution of the problem shows that a finite amount of magnetic field is produced in the direction of motion of the plasma. When the velocity of the medium is independent of time, the magnetic field produced in the direction of motion is proportional to $\sqrt{t}$, and any amount of magnetic field can be produced. Author

N64-33633* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IONIZATION OF THE HYDROGEN ATOM BY ELECTRON COLLISION
Kazem Omidvar Jul. 1964 67 p refs
(NASA-TM-X-55081; X-641-64-192) OTS: $3.00 fs; $0.75 mf

By the use of the parabolic coordinate a general formula is derived for ionization of the hydrogen atom by electron collision when the atom is in any given initial state. Using this formula the total ionization cross section and the ionization cross section per unit energy range of the ejected electrons for all substates of the hydrogen atom belonging to the principal quantum numbers n = 1, 2, 3, 4, 5 are tabulated. In addition, the ionization cross section of one substate from each of the principal quantum numbers n = 6, 7, 8, 9, 10 is tabulated. These tables cover the range of energies of interest in the plasma calculations. A Born approximation is used in which the bombarding electron before and after collision is described by a plane wave, and the ejected electron by a Coulomb wave function. Comparison with experiment for the ground state of the atom is given. Author

N64-33634* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXCITATION OF THE HYDROGEN ATOM BY ELECTRON COLLISION
Kazem Omidvar Jul. 1964 38 p refs
(NASA-TM-X-55082; X-641-64-193) OTS: $2.00 fs; $0.50 mf

Within the Born approximation and employing parabolic coordinates an expression is found that gives the cross section, induced by electron collision, for excitation of the hydrogen atom from any initial state to any final state. Using this expression the cross section in the energy range of interest in plasma calculations for the following transitions among the principal quantum numbers are tabulated: n = 1, n' = 2, 3, 4, 5, 6, 7, 8, 9, 10; n = 2, n' = 3, 4, 5, 6, 7, 8; n = 3, n' = 4, 5, 6, 7, 8; n = 4, n' = 5, 6; n = 5, n' = 6. A curve for the total inelastic collision of electrons and of the hydrogen atom in its first five energy levels is constructed. Author

N64-33635* Litton Systems, Inc., Beverly Hills, Calif. Adler/Westrex Communications Div.
NON-LINEAR CONSTANT-PROFILE WAVES IN A COLD PLASMA UNDER AN APPLIED MAGNETIC FIELD
Yves J. Alloucherie Greenbelt, Md., NASA. Goddard Space Flight Center, Jul. 1964 40 p refs
(Contract NAS5-2664)
(NASA-TM-X-55083; X-641-64-200) OTS: $2.00 fs; $0.50 mf

Nonlinear coupled differential equations for the two transverse components of the local magnetic field have been obtained for a plane wave propagating in a homogeneous cold Vlasov plasma under the influence of an external magnetic field B_0, for any angle $(90° - \alpha)$ between B_0 and the wave vector. There is one exact single valued solution and approximate multiple valued solutions for $\alpha = 90°$; for $\alpha = 0°$, the solution is reducible to an integral and is multiple valued. A perturbation method has been used to obtain a restricted class of solutions for intermediate angles. A numerical example has been worked out in detail for a specific value of the field energy density and for 12 different angles; the plasma parameters in this example are those appropriate to the ionosphere of the earth. Author

N64-33657 Elcon Lab., Inc., Watertown, Mass.
INTERACTION OF ELECTROMAGNETIC WAVES AND CLASSICAL PLASMAS Monthly Report No. 2
14 Aug. 1963 3 p
(Contract AF 33(657)-11671)
(R-8-63-2; AD-439839)

The initial experimental design utilizing the average electron theory to calculate the signal from the cross modulation of two microwave beams has been completed. The noise, bandwidth, and various detection schemes have been examined. A simple square-law detector for a narrowband system was calculated to be adequate, and a heterodyne detector was calculated to be necessary for a wideband system. A preliminary microwave lens design was completed. Several evaluation methods for the measured physical properties of the plasma are discussed. G.G.

N64-33663 Innsbruck U. (Austria) Inst. for Theoretical Physics
LEGENDRE TRANSFORMATION AND CHARACTERISTICS OF THE MAGNETOGASDYNAMIC POTENTIAL EQUATION
Ferdinand Cap 25 Feb. 1964 20 p refs
(Contract AF 61(052)-675)
(SR-7; AD-447833)

For the potential equation of the two-dimensional stationary potential flow of a plasma of infinite conductivity, a method of characteristics has been derived that is set up in analogy to the Prandtl–Busemann method of gas dynamics. Author

N64-33717 Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
CROSS-POLARIZED ELECTROMAGNETIC BACKSCATTER
R. S. Ruffine and D. A. De Wolf Jun. 1964 28 p refs
(Contract DA-36-034-ORD-3144Z; ARPA Order 51; Proj. Defender)
(DAMP-TM-64-01; AD-445295)

The cross section for incoherent backscatter by a turbulent, underdense plasma of electromagnetic radiation polarized orthogonally to the incident wave is carried out using the second Born approximation. It is shown that in the limit of $kV^{1/3} >> 1$ the only important contribution to the cross-section arises from scatterings between pair correlation cells, and as a consequence only the two-point density fluctuations $\Delta n(r_1)\, \Delta n(r_2)$ are needed. Author

N64-33824 General Motors Corp., Indianapolis, Ind. Allison Div.
MEASUREMENT OF FLUID PROPERTIES FOR MAGNETOPLASMADYNAMIC POWER GENERATORS Second Quarterly Technical Summary Report, 1 Aug.–31 Oct. 1963

R. T. Schneider, H. E. Wilhelm, D. L. Tipton, and W. Woerner
21 Nov. 1963 39 p refs
(Contract Nonr-4104(00); ARPA Order 420)
(Rept.-3632; AD-424152)

This is a report on the final loop for the Allison diagnostic magnetoplasmadynamic power device with emphasis on the description of the diagnostic methods used in the preparation of the loop. The final assembly is described, and some minor changes in the design are pointed out. Computations of the properties of cesium-seeded helium plasma were carried out by the ionization of cesium and helium. The equations for the theoretical solutions used temperature, seeding ratio, and pressure as variables. G.G.

N64-33827 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERACTION OF PLASMOIDS WITH EXTERNAL MAGNETIC FIELDS
N. A. Khizhnyak and B. G. Safronov 9 Mar. 1964 46 p refs
Transl. into ENGLISH from Fiz. Plazmy i Probl. Upravlyayemogo Termoyadernogo Sintez (Kiev) p 238–275
(FTD-MT-64-32; AD-605584)

A theoretical study of the motion of plasmoids in an external magnetic field was made by the description of the interaction of the plasmoids with external magnetic fields, considering the plasma nature of the plasmoid and its finite dimensions. The equations of longitudinal motion, transverse compression, and rotational motion are formulated; self-induction of the plasmoid and its conductance are calculated; questions of the interaction of plasmoids with fields of corklike configuration are discussed, as well as the behavior of the magnetic moment of the plasmoid. Conditions of the plasmoid repulsion from the magnetic field and of plasmoid capture are studied; equations are formed for the stability of the inductive plasmoid with general equations for its self-induction, for the interaction of long plasmoids with external fields, and for the collision of plasmoids. G.G.

N64-33878 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
CHARGED PARTICLE MOTION IN AN INHOMOGENEOUS MAGNETIC FIELD
Dalton N. Wirtanen (M.S. Thesis) Aug. 1964 97 p refs
(GSP/Phys/64-15; AD-603602)

The theory necessary to specify a distribution function for charged particles in an inhomogeneous magnetic field has been developed. The variation in the distribution function is to be related through a Folker–Planck formulation to the average behavior of individual particles. A transfer function is used to define the probability that particles will go from a given state A to a state B in a characteristic distance traveled. The equations of motion for the particles have been derived to evaluate the moments of the transfer function. To solve the equations of motion for the behavior of individual particles, the inhomogeneous magnetic field must be specified. The magnetic field due to two specific magnetic traps is calculated. The motion of the charged particles in the infinite conductor configuration has been numerically calculated. Author

N64-33966 Naval Ordnance Lab., White Oak, Md.
A NON-UNIFORM-PLASMA, ELECTRICAL-CONDUCTIVITY PROBE
Alan H. Luther 30 Aug. 1963 62 p refs
(NOLTR-63-165; AD-422730)

The penetration of a radio-frequency magnetic field into a cylindrically symmetric conducting medium can be used to calculate the conductivity. At a particular point, the ratio of the rf magnetic field gradient to the rf magnetic field is a measure of the conductivity at that point. These conductivity calculations are found to be relatively insensitive to errors caused by conductivity gradients. Consequently, this technique can be used to measure conductivity space variations. Experiments with uniform salt solutions and solutions containing conductivity gradients are used to check accuracy. The results of the application of this technique to conductivity measurement of a plasma produced by a one-megawatt electric arc-jet are presented. Author

N64-33992* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
EVIDENCE FOR A COLLISION-FREE MAGNETOHYDRODYNAMIC SHOCK IN INTERPLANETARY SPACE
C. P. Sonett, D. S. Colburn, L. Davis, Jr. (Calif. Inst. of Tech., Pasadena), E. J. Smith (JPL), and P. J. Coleman, Jr. (Calif. U., Los Angeles) repr. from Phys. Rev. Letters, v. 13, no. 5, 3 Aug. 1964 p 153–156 refs
(NASA-RP-362)

A rapid, apparently irreversible change in the interplanetary plasma and magnetic field was seen on 7 October 1962 by Mariner II, when it was 10.6×10^6 km from earth, and 38° to the left of the earth–sun line as seen by an earth observer facing the sun. This event appears to be a hydromagnetic shock with a structure that is vanishingly thin compared to the mean free path, but on detailed examination of the data and extensive calculations, it shows the characteristics of a magnetohydrodynamic shock of spherical shape, originating at the sun, and propagating outward at a velocity of 510 km/sec. All measurements and calculated parameters agree within the limits of measurement accuracy. D.E.W.

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see:* 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-32746 Joint Publications Research Service, Washington, D.C.
THE PHYSICS OF SUPERCONDUCTING ALLOYS
A. A. Abrikosov 12 Oct. 1964 14 p Transl. into ENGLISH from Priroda (Moscow), no. 5, May 1964 p 26–33
(JPRS-26862; TT-64-51119) OTS: $1.00

This paper discusses some properties of superconductors and superconductor alloys, with emphasis on the superconductive magnets. The first-group superconductors are converted into second-group superconductors by introduction of extraneous atoms or some other damage. A theory is developed for the transition of uniform superconductors of the second group to a normal state as a result of their penetration by an external magnetic field. G.G.

N64-32749 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE PARAMAGNETIC PROPERTIES OF CHLOROPHYLL AND ITS ANALOGS
A. V. Umrikhina et al 15 Oct. 1964 10 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 9, no. 4, 1964 p 423–427
(JPRS-26915; TT-64-51172) OTS: $1.00

The electron paramagnetic resonance of several pigments by radiospectrometer at low-intensity klystron radiation was observed. In the dark, all pigments gave an EPR signal with

similarity in the g-factor value and the line width, indicating that the unpaired electrons observed must be ascribed to the pigments. The effects of light, temperature, and oxygen on the type and magnitude of the detected signal were investigated. G.G.

N64-32773* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
CRYOGENIC AND SUPERCONDUCTING DEVICES
Edmund E. Callaghan *In its* Conf. on New Technol. 1964 p 105–111 (See N64-32767 24-01) GPO: $1.00

Both cryogenic but nonsuperconducting and superconducting devices are discussed. The former exhibit a decrease in resistivity with lowered temperature; the thermal resistance, magnetoresistance, and applications of these normal conductors are considered. Next, the three properties inherent in superconducting materials—zero resistance, sharp definition of the superconducting domain, and exclusion of a magnetic field—are discussed, and the applications of these materials in electrical, energy-storage, and ac–dc conversion devices are indicated. M.P.G.

N64-32817 National Bureau of Standards, Boulder, Colo. Cryogenics Div.
THE ELECTRICAL PROPERTIES OF ALUMINUM FOR CRYOGENIC ELECTROMAGNETS
R. J. Corruccini 30 Aug. 1964 39 p refs
(NBS-TN-218) GPO: $0.30

The published data for the ideal resistivity and the magnetoresistivity of aluminum have been correlated. It is shown that both properties can be calculated for the limited ranges of temperature and purity that are of importance for aluminum cryogenic electromagnets from the residual resistivity ratio alone. Empirical functions are given for these properties, and sample calculations are given of the figure of merit for a particular aluminum solenoid relative to the same solenoid using water-cooled copper. Author

N64-32825* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
INTERACTION OF VERY INTENSE RADIATION FIELDS WITH ATOMIC SYSTEMS
Oldwig von Roos Repr. from Phys. Rev., v. 135, no. 1A, 6 Jul. 1964 p A43–A50 refs
(Contract NAS7-100)
(JPL-TR-32-599)

A theory is developed to treat radiation processes involving a large number of photons in first- or second-order perturbation theory. The theory is applied to the interaction of an atomic electron with a very intense linearly polarized laser beam. It is found under certain approximations that induced radiation will occur at all harmonics $n\omega_0$ of the fundamental laser frequency ω_0. The intensity distribution of this radiation is symmetric about the axis of polarization of the primary beam and is peaked at an angle of about 45° with respect to direction of propagation of the secondary radiation and the polarization of the incident radiation for the first few modes. This angle markedly shifts toward 0° for increasing n (higher harmonics). The transition probabilities are high enough to make the effect readily observable. Author

N64-32844 Joint Publications Research Service, Washington, D.C.
ELECTRICAL PROPERTIES OF OXIDE FILMS ON BARRIER-LAYER METALS AND THE MECHANISM OF ELECTROLYTIC RECTIFICATION
I. S. Zhukova and L. L. Odynets *In its* Phys. of Semiconductors and Metals 7 Oct. 1964 p 21–50 refs (See N64-32842 24-18) OTS: $3.00

Several experiments were performed to determine the static and dynamic volt-amperes characteristic of an electrolytic rectifier and the electrical properties of dry oxide films. Four theories of local rectification are discussed: gas, electroosmatic, rectification by defect, and electrochemical. Three theories are presented connecting rectification with processes occurring inside the oxide layer: space charge, hydrogen introduction, and p-n transition. Analysis of all the basic positions results in the conclusion that the mechanism of electrolytic rectification is best described by theories that connect it with processes occurring on the boundary oxide layer and on the defect sections of the oxide layer. A.W.

N64-32847 Joint Publications Research Service, Washington, D.C.
THE METHOD OF FOURIER-ANALYSIS OF INTERFERENCE LINES FOR SEPARATION OF EFFECTS OF BROADENING AS A RESULT OF MICRO-DISTORTIONS OF THE LATTICE AND OF THE DISPERSIVENESS OF THE BLOCKS
O. N. Shivrin *In its* Phys. of Semiconductors and Metals 7 Oct. 1964 p 71–80 refs (See N64-32842 24-18) OTS: $3.00

The separation of the effects of broadening of interference lines by Fourier analysis can be carried out either by analyzing several lines (reflections from one family of planes in different order), or by analyzing only an interference line. In the second case, the solution of the problem is possible only under certain additional assumptions on the form of the expansion coefficients A_L^{bl} and A_L^d corresponding to the line broadening due to "block character" and to "distortion." In particular, to estimate the coefficients A_L^{bl}, the derivative $\delta A_L|_{L=0} = -1/D$, δL $(A_L = A_L^{bl} \cdot A_L^d)$ and construction of the dependence of A_L^{bl} (L) are found in explicit form; for instance, A_L^{bl} (L) $= 1 - L/D$ or $A_L^{bl}(L) + \exp(-L/D)$. Author

N64-32849 Joint Publications Research Service, Washington, D.C.
THE APPLICATION OF PRELIMINARY ELECTROSPARK TRANSFER IN SPECTRAL ANALYSIS
M. N. Palladin, V. S. Baskov, and A. I. Koroleva *In its* Phys. of Semiconductors and Metals 7 Oct. 1964 p 92–98 refs (See N64-32842 24-18) OTS: $3.00

A sampler was designed that does not use a vibrator for contacting the electrodes; a thyratron is controlled by the discharge of a capacitor. Two electrodes (one of which is the sample, the other the sampler) are in the anode circuit of the thyratron. In the mechanical transfer of one electrode over the surface of the other, periodic spark discharge takes place between them. The frequency of selection is determined mainly by the parameters of the circuit (voltage, current, grid bias, polarity of the electrodes, etc.). The apparatus can be quickly set up from small-size parts by using rectifiers made with semiconductors. A.W.

N64-32850 Pennsylvania U., Philadelphia
STATISTICAL MECHANICS AND PHASE TRANSITIONS OF THE HEISENBERG ANTIFERROMAGNET
F. Burr Anderson and Herbert B. Callen Apr. 1964 90 p refs
(Contract Nonr-551(36))
(TR-15; AD-601726) OTS: $3.00

The spin-flop and flop-para phase transitions of a simple uniaxial antiferromagnet are analyzed by a Green function analysis. The temperature dependence of the field for antiferromagnetic resonance, the parallel and perpendicular susceptibilities, and the sublattice magnetizations are also

computed. It is shown that these effects are sensitive to the temperature-dependent renormalization of spin-wave energies, and this effect is analyzed in some detail. Author

N64-32875 Ohio State U. Research Foundation, Columbus Antenna Lab.
PEAK POWER LIMITER FOR LARGE LASER PULSES
R. G. Tomlinson and E. K. Damon 1 Jul. 1964 13 p
(Contract AF 33(657)-10824)
(Rept.-1579-13; AD-443785)

This report describes a device that limits the peak amplitude of a high-power laser pulse. Control is achieved through an electrodeless discharge produced by the laser pulse in a gas or liquid. For a properly designed system, the peak amplitude of a pulse passing through the power limiter is directly proportional to the pressure of the gas in the limiter provided the pulse entering the limiter exceeds the critical value for that particular system, gas, and gas pressure. The device is passive and lossless, so that it can be used inside or outside the cavity. Some experimental data on the operation of the power limiter using argon as the working substance are presented. Author

N64-32925 Oak Ridge National Lab., Tenn.
SOLID STATE DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING MAY 31, 1964
O. S. Oen et al Oct. 1964 203 p refs
(Contract W-7405-ENG-26)
(ORNL-3676) OTS: $3.00

A series of papers related to solid-state physics is presented. Papers are grouped under theory, crystal physics, metals, nonmetals, radiation metallurgy, and technology. Extensive space is devoted to papers on semiconductor studies, insulating crystals, elasticity and anelasticity studies, and radiation-damage theory; these are some of the numerous groups listed under the subject headings. D.E.W.

N64-32971 Massachusetts Inst. of Tech., Cambridge
THE RELATIONSHIP OF YIELD STRENGTH TO ATOMIC BONDING IN THE TELLURIDES OF ZINC, CADMIUM AND MERCURY
F. J. Bachner and D. A. Thomas [1962] 19p refs
(Contract Nonr-1841(82))
(AD-418732)

An attempt to relate mechanical properties to atomic bonding in a series of similar compounds with systematic variations in bonding is discussed. Three isoelectric tellurides were studied—zinc telluride, cadmium telluride, and mercury telluride. Stress-deflection curves for the three materials are presented. Zinc telluride behaved elastically, until fracture at a stress of approximately 7100 psi. The yield stress of cadmium telluride, taken to be the first deviation from a linear stress-deflection relationship, was approximately 4800 psi. The yield stress for mercury telluride was approximately 1500 psi. For both the cadmium telluride and mercury telluride specimens, the amount of plastic deformation preceding fracture depended on the surface condition and size of the particular specimen. Microhardness data gave results that were related to the yield stress. The data show that the microhardness values increase in the same order as the yield strength. The microhardness on the [110] plane is always lower in the [110] direction than in the [001] direction. P.V.E.

N64-32973 Stanford Research Inst., Menlo Park, Calif.
BETA-SILICON CARBIDE AND ITS POTENTIAL FOR DEVICES Quarterly Technical Report No. IV, 1 Nov. 1962–31 Jan. 1963
W. E. Nelson 15 Feb. 1963 13 p refs
(Contract NObsr-87235)
(Rept.-12; AD-297821)

This article describes single crystals of B-silicon carbide with metallic impurity levels below those detectable by ordinary emission spectroscopy. The improved resistivities ranged from 1 to 160 ohm/cm and are attributed to improved starting purity by reducing the nitrogen and other impurities from silicon melts in graphite crucibles, as well as in a purified furnace atmosphere. Analysis of a specially purified silicon revealed only 1-ppm nitrogen contamination. G.G.

N64-32985 Northwestern U., Evanston, Ill. Materials Research Center
1962–1963 ANNUAL REPORT, MATERIALS RESEARCH CENTER, NORTHWESTERN UNIVERSITY
Jul. 1963 128 p refs
(Contract ARPA-SD-67)
(AD-420653)

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N64-33016 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

SPACECRAFT APPLICATIONS OF SUBLIMING MATERIALS

Robert E. Fischell and Louis Wilson Aug. 1964 35 p refs

(Contract NOw-62-0604-c)

(TG-593)

Three sublimation materials (camphor, naphthalene, and biphenyl) have been studied in considerable detail both in the laboratory and on orbiting satellites. A principal use of these materials is to actuate electrical switches with a predetermined time delay after the spacecraft is placed in the vacuum of space. These materials can also be used as a temporary mechanical structure that sublimes away after the spacecraft is launched. A third useful characteristic of these materials is that they can be used for encapsulation of delicate instruments during the severe vibration and acceleration environment encountered during a launching operation. Once in orbit, the encapsulation material gently sublimes away leaving the delicate mechanism free to work in the vibrationless, zero-g environment of space. Author

N64-33029 Colorado U., Boulder Atmospheric and Space Physics Lab.

REFLECTIVITY OF METALS IN THE EXTREME ULTRAVIOLET Scientific Report No. 3

Wilfred Theisen Dec. 1963 38 p refs

(Contract AF 19(628)-287)

(AFCRL-63-927; AD-427095)

The reflectivity values of thin gold or silver films in the ultraviolet region of the spectrum are investigated by analytical quantum mechanical formulation and by experimental testing with an ultraviolet monochrometer containing a Geissler tube and a concave grating. In an electrostatic generator, a mount was constructed that contains a metal plate and a mirror. Opaque silver or gold films were deposited on the mirror surfaces and on the plate, and the electrical contact was made by a copper clamp. Reflectivity measurements made with or without charge on the mirror or plate showed no difference. G.G.

N64-33119* Smithsonian Astrophysical Observatory, Cambridge, Mass.

COATED METALLIC GRAINS AS A SOURCE OF INTERSTELLAR ABSORPTION LINES

Charles A. Whitney 11 Sep. 1964 29 p refs

(Grant NsG-87-60)

(NASA-CR-59170; SAO Special Rept.-163) OTS: $2.00 fs; $0.50 mf

A. Unsöld has suggested that interstellar absorption bands may be produced by plasma resonance in small metallic particles. This paper describes a theoretical and experimental investigation of this suggestion. It is shown that grains of sodium produce an absorption band at λ3700 Å. If these grains were to be coated with ordinary ice, the band would shift to the vicinity of the λ4430 Å band observed in the spectra of highly reddened stars. Author

N64-33140 Joint Publications Research Service, Washington, D.C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 117: MOSSBAUER EFFECT OF Fe^{57} 14.4 KEV γ RAY

Hsu Ying-ting, Ma Chi-mou, Wang Yu-fu, and Hsieh Pao-chen 23 Oct. 1964 8 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 7, 17 Jul. 1964 p 617–619

(JPRS-27049; TT-64-51305) OTS: $3.00

A deuterium bundle with an energy of 12 000 keV from an accelerator was used to bombard a pure-iron target in order to obtain the reaction $Fe^{56}(\alpha,n)\ Co^{57}$. The Co^{57} was deposited on stainless-steel plate. The low-energy section of the scintillation section of the stainless-steel Co^{57} source was obtained. The photoelectric crest of the 14.4-keV γ-ray showed most clearly at 35 volts. Also discussed is the resonant-absorption-speed spectrum. P.V.E.

N64-33145 Naval Research Lab., Washington, D.C. Optics Div.

LASER RESEARCH Progress Report, 1 Jan.–30 Jun. 1964

J. W. Tucker and J. N. Bradford 31 Jul. 1964 22 p

(NRL-1553; AD-445026)

This report reviews recent laser work. Topics covered include ruby relaxation and fluorescent phenomena, a high-resolution spectrograph that repetitively scans and displays a narrow wavelength interval, a flash lamp operable at 77° K, and evaluation of the optical quality of ruby. Author

N64-33148 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.

ELECTRON SPIN RESONANCE Yearly Progress Report No. 6

M. A. Fischler and D. E. Kaplan Jun. 1964 34 p refs

(Contract Nonr-2541(00))

(Rept.-3-53-64-2; AD-445004)

The zero-field paramagnetic resonance spectra of weak crystalline field sites of cerium and praseodymium in calcium fluoride are presented with tentative conclusions regarding the symmetry of these sites. Preliminary relaxation time data on cerium-doped calcium oxide are given. Considerations attendant to the utilization of helical slow-wave structures for microwave spin-echo experiments are discussed. A new proposal for a computer associative memory utilizing spin-echo devices is given. Author

N64-33153* Texas U., Austin Electrical Engineering Research Lab.

SOLAR RADIATION AT 3.2 MM DURING THE JULY 20, 1963, ECLIPSE

C. W. Tolbert, L. C. Krause, and A. W. Straiton Repr. from Astrophys. J., v. 140, no. 1, 1 Jul. 1964 p 306–312 refs

(Grant NsG-432; Contract AF 19(628)-1679)

The 3.2-mm solar radiation was investigated by circularly scanning the limb of the moon across the sun during the July 20, 1963 solar eclipse. A 60-in. searchlight antenna with a beamwidth of 9 ft was used. A significant amount of radiation was measured from prominences on the southeast and the southwest limbs. The antenna temperature when observing the southeast prominence was approximately equal to the antenna temperature when observing a crescent segment of the sun that is 1/150 of the sun's diameter. No systematic limb brightening was observed. IAA

N64-33176* Ohio Semiconductors, Inc., Columbus, Ohio
DEVELOPMENT OF IMPROVED THERMOELECTRIC MATERIALS FOR SPACECRAFT APPLICATIONS Final Summary Report, Apr. 29–Jul. 29, 1964
A. E. Middleton [1964] 75 p refs
(Contract NAS8-11075)
(NASA-CR-59203) OTS: $3.00 fs; $0.75 mf

The problems faced in improving Z_p beyond that achieved in present-day production and in improving laboratory materials were identified in detail. Suitable wide-temperature-range evaluation facilities were developed to give, Z_p, S, k_T, σ, R_H, and μ, as a function of temperature over the range from 78° to 560° K for experimental materials. Bismuth antimonide alloy crystals and silver antimony telluride alloys were prepared that are nearly representative of the state-of-the-art for thermoelectric cooling, and bismuth crystals were prepared that are nearly representative of the state-of-the-art for thermomagnetic cooling. Alloy modification studies were begun in the silver antimony telluride alloy system, using the selection principles evolved in the interdisciplinary identification studies. D.E.W.

N64-33240 Naval Ordnance Lab., Corona, Calif.
MAGNETORESISTANCE IN METALS, SEMICONDUCTORS, AND ALLOYS: A BIBLIOGRAPHY ON THEORETICAL AND EXPERIMENTAL ASPECTS Comprehensive Bibliography, 1930–1963
L. E. Leonard 15 Jul. 1964 97 p refs
(NAVWEPS-8191; AD-603359)

N64-33258 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
RELATION BETWEEN THE TRANSFER FUNCTIONS AND THE EXPERIMENT IN THE MECHANICS OF DEFORMABLE SOLIDS [RELATION ENTRE LES FONCTIONS DE TRANSFERT ET L'EXPERIENCE DANS LA MECANIQUE DES SOLIDES DEFORMABLES]
Henri Le Boiteux [1964] 22 p refs In FRENCH Presented at the 11th Intern. Cong. on Appl. Mech., Munich, 30 Aug.–5 Sep. 1964
(ONERA-TP-161)

The experimental application of the concept of the transfer function gives an introduction to the theoretical study of the deformation of solids that proves very fruitful; however, it necessitates particular precautions concerning the application of the influencing forces. Thanks to the use of a new machine that assures precision in the application of a previously chosen programed standard of loading and unloading, it is possible to verify the theory of elasticity by the previously proposed delay. The choice of the program of influencing forces permits the calculation of the characteristic coefficients of viscosity. The application of this technique to Plexiglass is demonstrated. Finally, by comparison with results obtained previously, the influence of aging of the material is revealed. A systematic study of these phenomena is in progress. Trans. by M.P.G.

N64-33281* Massachusetts Inst. of Tech., Cambridge Energy Conversion and Semiconductor Lab.
FUNDAMENTAL RESEARCH IN SOLID STATE ENERGY CONVERSION PROCESSES Semiannual Technical Summary Report No. 2, 1 Dec. 1963–31 May 1964
John Blair et al 30 Jun. 1964 58 p refs
(Grant NsG-496)
(NASA-CR-58763) OTS: $3.00 fs; $0.75 mf

Experiments on aluminum antimonide-gallium antimonide heterojunctions revealed that the photovoltaic response of such structures is governed by a combination of photoemission and field emission. Optical measurements of diffused mercury telluride–cadmium telluride graded energy-gap structures indicated photovoltaic response at wavelengths well beyond the fundamental absorption of cadmium telluride. Additional refinements were introduced in the process of preparing single crystals of zinc antimonide. The apparatus for galvanomagnetic measurements on this material was in operation, and preliminary data were obtained. The principal anisotropic thermal expansion coefficients of zinc antimonide were measured over a broad temperature region with an rf dilatometer. D.E.W.

N64-33332* Ohio State U. Research Foundation, Columbus Antenna Lab.
PROPERTIES OF MATERIALS FOR SUBMILLIMETER MASERS
W. S. C. Chang and R. F. Rowntree 5 Feb. 1963 13 p refs /tr Rept.-1093-12
(Grant NsG-74-60)
(NASA-CR-59288) OTS: $1.00 fs; $0.50 mf

The particular conditions that are necessary to successfully operate a solid-state submillimeter maser, and the measured properties of the host lattice and of the cavities are discussed. It is concluded that the selected active material must have a resonance absorption Q equal to 10^3 or better (i.e., the resonant absorption coefficient, K_{st}, must be approximately 1 cm^{-1}) with a population inversion ratio of 10% or better. Also, any material in which an electric dipole transition does not occur will probably not make a good submillimeter maser material. From existing submillimeter spectroscopic data in solids, it appears that K_{st} of this order of magnitude should be available in many materials, and that the major obstacle would be the achievement of a reasonable population inversion ratio. D.S.G.

N64-33338 Weizmann Inst. of Science, Rehovoth (Israel)
NONLINEARITY OF THE SUSCEPTIBILITY IN WEAK FERROMAGNETS AND ANTIFERROMAGNETS
S. Shtrikman and D. Treves 1 Aug. 1964 7 p refs
(Contract AF 61(052)-654)
(TN-7; AD-605720)

The symmetry of the tensor describing the quadratic dependence of the magnetization on an applied field is studied for the various magnetic point groups. It is described by at most one parameter in antiferromagnetic materials, and up to ten in ferromagnetic materials. This parameter is calculated from basic principles to various approximations for FeF_2 and CoF_2. The estimates are in the range 10^{-8} to 10^{-9} emu/mole Oe^2 for FeF_2 and 10^{-7} emu/mole Oe^2 for CoF_2. Author

N64-33362 Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
A FORMULATION OF THE GRUNEISEN PARAMETER FOR MONATOMIC CUBIC CRYSTALS
D. John Pastine Nov. 1964 14 p refs
(NOLTR-64-143; AD-449747)

A formulation of the temperature independent Grüneisen parameter γ is presented in terms of the lattice parameters a, b, and c of a monatomic cubic crystal. The formulation includes the effects of Poisson's ratio, σ, and the modified Cauchy relation. The modification of γ introduced by these latter quantities is seen to be significant. In particular, a correction generated by consideration of the variation of σ with volume is shown to account for differences between the Slater and Dugdale–MacDonald formulas for γ. Author

N64-33409* National Aeronautics and Space Administration, Washington, D.C.
MEASUREMENTS AT LOW TEMPERATURES AND HIGH PRESSURES. II: SUPERCONDUCTIVITY OF Sn AND In UNDER UNIFORM COMPRESSION AT A PRESSURE OF 1750 KG/CM^2 [IZMERENIYA PRI NIZKIKH TEMPERATURAKH PRI VYSOKIKH DAVLENIYAKH. II: SVERKHPROVODIMOST' Sn I In PRI VSESTORONNEM SZHATII DAVLENYEM 1750 KG/CM^2]
B. Lazarev and L. Kan Oct. 1964 30 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 14, no. 12, 1944 p 463–473
(NASA-TT-F-9152) OTS: $2.00 fs; $0.50 mf

Studies on the superconductivity of Sn and In at a pressure of 1750 kg/cm^2 (±2.3%) are described. A displacement in the superconductivity temperature of tin, $\Delta T_k = 0.98 \pm 0.006°$, occurs at this pressure, along with a displacement in the critical magnetic field of $\Delta H_k = 13.5 \pm 0.5$ Gauss. A comparison of the results obtained with the Leyden data shows that ΔT_k and ΔH_k increase linearly with pressure up to a pressure of ~2000 kg/cm^2. A measurable volume change (in the magnetic field) and a change in the expansion coefficient should be observed during superconductive transition. The reason for the transition point diffusion in a tin polycrystal is discussed. Author

N64-33418 Martin Co., Orlando, Fla. Materials Research Lab.
THE CALCULATION OF ELECTRON DIFFRACTION PATTERNS CONTAINING TWIN REFLECTIONS
A. G. Crocker Jul. 1964 12 p refs *Its* Technical Rept.-8 Submitted for Publication
(Contract Nonr-3706(00))
(OR-6112; AD-444414)

The positions of twin reflections in electron diffraction patterns obtained from thin metal foils may be calculated for any twin in any crystal structure by means of an elementary application of vector algebra. General equations for the four classical orientation relationships are presented using the superscript and subscript notation of the tensor calculus, which is briefly described. As an example of the application of these expressions, the case of twinned rhombohedral crystals and, as a special case, twinned cubic crystals, is examined. Author

N64-33454* Chicago U., Ill.
EVIDENCE FOR A NEW COLLECTIVE RESONANCE IN A "FREE-ELECTRON" METAL
M. H. Cohen and J. C. Phillips Repr. from Phys. Rev. Letters, v. 12, no. 24, 15 Jun. 1964 p 662–664 refs
(Grant NsG-352)

Salient results are reviewed of another study of the reflectance of polarized light from mirror surfaces of metallic potassium at temperatures between −183° and +85° C. Some paradoxical relationships in these results are discussed, and it is suggested, as the most likely explanation for this resonance, that the Landau framework itself fails for potassium, and that potassium can no longer be regarded as a normal metal. D.E.W.

N64-33531 Unified Science Associates, Inc., Pasadena, Calif.
ELECTRON EMITTING PROPERTIES OF SMALL PARTICLES Final Report
S. Naiditch Oct. 1964 46 p refs
(Contract AF 19(628)-1667)
(AFCRL-64-689; AD-607095)

The purpose of the program was to investigate the ionization potentials of *small* particles as a function of particle size. Three types of particles were prepared for various aspects of this program: (1) cesium antimonide particles grown in ammonia; (2) polydispersed aluminum particles grown in a carrier gas to minimize contamination; and (3) monodispersed sulfur particles grown in water. The objectives of producing each type of particle were to provide particles of low work function, high chemical purity without appreciable surface contamination, and single size, respectively. To size particles, the technique using monochromatic X-rays was tried with graphite particles. A sensitive method for the detection of heavy charged particles in a carrier gas was investigated. Author

N64-33598 Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
SOME NONLINEAR PROPERTIES OF ELECTRON-HOLE PLASMAS SUSTAINING THE HELICAL INSTABILITY
Betsy Ancker Johnson Apr. 1964 37 p refs
(D1-82-0339; AD-602670)

Electron-hole plasmas in p-InSb are driven far beyond the threshold of the helical instability into the nonlinear region by applying axial magnetic fields B much greater than the threshold fields B_{th}. While the plasma is immersed in a static B, three fundamental properties of the plasma, namely the electric field strength E sustained in the plasma, the self-magnetic field B_h produced by the rotating plasma, and the frequency of helical oscillations f, are measured. As B is increased from zero, E first decreases until $B = B_{th}$; then E rises with a slope and magnitude greater than those associated with the decrement. The quantity B_hR/I_T, where I_T = total current and R = radius, possesses a maximum as a function of BR. At constant I_T, f exhibits a trend to increase with increasing penetration into the nonlinear region until the onset of turbulence. Between this limit and the instability threshold, as many as three modes, defined by their distinct frequency ranges, are observed. Author

N64-33599 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
THE FREQUENCY-DEPENDENT ELECTRICAL CONDUCTIVITY OF POWDERS: NICKEL OXIDE
D. P. Snowden, H. Saltsburg, and J. H. Pereue, Jr. 17 Oct. 1963 18 p refs Submitted for Publication
(Contract DA-44-009-ENG-4832; ARPA Order 223-61)
(GA-4494; AD-424878)

The frequency-dependent conductivity of powdered NiO, both undoped and doped with Cr^{3+}, has been studied. A qualitative discussion is given of the causes of conductivity dispersion in powdered materials. Both the effects of the powder structure (interparticle contacts, surface resistance, etc.) and of intrinsic losses independent of the powder structure (dielectric losses, hopping-type conductivity, etc.) are considered. In undoped NiO it is argued that the observed conductivity dispersion is due to the hopping type of conductivity, which masks any possible structure due to the powdered nature of the material. In Cr^{3+}-doped NiO, however, a structure observed in the frequency-dependent conductivity is interpreted as being caused by a nonuniform distribution of Cr^{3+}, the Cr^{3+} being concentrated on the surface of the powder particle. Additional evidence confirming this interpretation is given. Author

N64-33643 Lockheed Missiles and Space Co., Sunnyvale, Calif.
APPLICATION OF ELECTRON SPIN ECHO RESONANCE PHENOMENA Technical Report No. 4
M. M. Siera Jun. 1964 60 p refs
(Contract Nonr-2541(00))
(Rept.-3-53-64-1)

A general description of the spin echo resonance phenomenon in paramagnetic electron systems is given, and a basic analysis determining some engineering parameters is presented. The use of slow wave structures is investigated, and a number of possible applications of the electron spin echo resonance mechanism are discussed. Author

N64-33658 Pennsylvania U., Philadelphia Lab. for Research on the Structure of Matter
SPIN WAVES IN THE SPIN-FLOP PHASE OF AN ANTIFERROMAGNET, AND METASTABILITY OF THE SPIN-FLOP TRANSITION Technical Report No. 14
Yung-Li Wang and Herbert B. Callen Mar. 1964 14 p refs
(Contract Nonr-551(36))
(AD-435887)

The spin-flop transition in a uniaxial antiferromagnet defines three critical fields; that of the true thermodynamic transition and those limiting the local stability of antiferromagnetic and spin-flop phases. The latter two are calculated by a spin-wave analysis. The results are in qualitative agreement with the hysteresis observed in the spin-flop transition in $MnBr_2 \cdot 4H_2O$. The spin-wave spectrum of the spin-flop phase is given, and the magnetization in the spin-flop phase is found to increase more rapidly than linearly with field because of quantum corrections absent in molecular field theory. Author

N64-33661 Genoa U. (Italy) Istituto di Fisica Sperimentale
SCIENTIFIC REPORT ON THE SOLIDIFIED INERT GASES
Giovanni Boato 5 Mar. 1964 38 p refs Submitted for Publication
(Contract DA-91-591-EUC-2861)
(AD-448620)

This study contains a survey of the properties of solidified inert gases as typical molecular solids with emphasis on the determining effect of zero-point energy. Recent experimental and theoretical advances in the knowledge of lattice and thermal properties are presented, and the need for a realistic potential of lattice dynamics of solidified inert gases is indicated. G.G.

N64-33664 Cambridge U. (Gt. Brit.) Cavendish Lab.
A STUDY OF FERROELECTRIC MATERIALS Quarterly Technical Status Report, 1 Oct.–31 Dec. 1963
W. H. Taylor 29 Jan. 1964 7 p refs
(Contract DA-91-591-EUC-3055)
(AD-442752)

Sodium niobate was studied at high temperatures of about 510° and 600° C, and preliminary results indicate that the niobium atom is displayed along the tetrad axis. The low-temperature structure of sodium niobate will be studied by X-ray diffraction methods. A low-temperature camera was developed for this purpose from a modified Weissenberg camera, and some room temperature oscillation photographs and one low-temperature photograph have been taken. G.G.

N64-33666 Carnegie Inst. of Tech., Pittsburgh, Pa.
EXPERIMENTAL STUDY OF THE BAND STRUCTURE IN THE IRON SERIES OF TRANSITION ELEMENTS Progress Report, Oct. 1963–Mar. 1964
James A. Dreesen and Emerson M. Pugh [1964] 4 p
(Contract DASA-WEB-07.010; Grant DA-ARO(D)-31-124-G278)
(PR-4; AD-447854)

A new 120-kW magnet power supply has been installed and tested. It is designed to furnish a continuously variable magnetic current from about 7 to 400 amperes, with a regulation of one part in 10^5. Measurements of the ordinary and extraordinary Hall constants and of the resistivity and magnetoresistance of alloys of iron, with various percentages of chromium, were started. G.G.

N64-33670 Carnegie Inst. of Tech., Pittsburgh, Pa. Metals Research Lab.
THE DEFORMATION OF PURE FACE-CENTERED CUBIC CRYSTALS Progress Report No. 15, 16 Oct. 1963–15 Apr. 1964
Albert L. Hoffmanner 15 Jun. 1964 28 p refs
(Contract AF 33(616)-6418)
(AD-447829)

The deformation characteristics of high-purity faced lead and gold single crystals were studied at temperatures from 77° to 300° K by incremental loading creep tests in shear and in strain-rate-change tests in tension, and by theoretical calculations. The "activation volume" v was gained by evaluation of the stress dependence of the strain rate. The v can be related to any value of the strain by a temperature-independent and strain-dependent quantity. Calculations on the interaction and intersection of dislocations in terms of macroscopic aspects of the crystalline flow in a lattice are presented. The following topics are presented: "The Stress Relaxation of Zone-Refined Iron at 77° K"—new aspects of stress relaxation at low temperatures with respect to time; "Resistometric Study of the Deformation of Iron at 77° K"—the use of isochronal and isothermal annealing at temperatures between 77° and 300° K for the investigation of migrational kinetics of the point defects produced by the temperature deformation; and "Investigation of the Bauschinger Effect." G.G.

N64-33671 Cambridge U. (Gt. Brit.) Cavendish Lab.
A STUDY OF FERROELECTRIC MATERIALS Quarterly Technical Status Report, 1 Jan.–31 Mar. 1964
W. H. Taylor 25 Apr. 1964 7 p refs
(Contract DA-91-591-EUC-3055)
(QTSR-2; AD-447831)

Studies of sodium niobate were made by the use of X-ray and dielectric measurements at room temperature and at elevated and low temperatures. Photos taken at −180° C of sodium niobate crystals did not show any changes in the crystal structure when compared to photos taken at room temperatures. Dielectric measures calculated from capacitances at temperatures between 20° and −195° C produced changes in some crystals. Crystals with a b-axis perpendicular to the large faces were either heated quickly to 650° C and then air cooled, or were heated slowly to 1000° C and then cooled at the rate of 25° C per hour. The X-ray photos taken before and after the heat treatment revealed a reorientation of the b-axis from the direction parallel to the large faces into the direction perpendicular to these faces. G.G.

N64-33676* New Mexico U., Albuquerque Engineering Experiment Station
MAGNETORESISTANCE, SUPERCONDUCTIVITY AND THE HALL EFFECT FOR INVERTER APPLICATIONS Annual Report, Jun. 1963–Jun. 1964

Richard Bechtel, Sang So Pak, and W. W. Grannemann Aug. 1964 49 p refs
(Grant NsG-279-62)
(NASA-CR-59188; EE-115) OTS: $2.00 fs; $0.50 mf

Several Dewar superconductivity measurements were obtained on various magnetoresistor configurations at liquid-nitrogen temperature in relatively low magnetic fields. Two tests were made, but the results were not conclusive. Magnetoresistance samples of ultrahigh-purity carbon were discarded as unusable; but one superconductor wire sample of a 6-foot piece of 20-mil niobium wire, with an insulating copper coil as a field coil, was developed for further testing. A mathematical solution was obtained for a multiterminal Hall generator, and a general equivalent circuit for the N output terminal was developed. The experimental values were found to be accurate within 10%. This multiterminal Hall generator may be used as a dc-to-ac converter by application of an alternating magnetic field. G.G.

N64-33694* Ohio State U. Research Foundation, Columbus Antenna Lab.
MEASUREMENTS OF THE OPTICAL CONSTANTS OF MAGNESIUM OXIDE AND CALCIUM TUNGSTATE IN THE SPECTRAL REGION BETWEEN 10 cm^{-1} AND 100 cm^{-1} AT 300°K AND 90°K
R. F. Rowntree (Ph.D. Thesis) 28 Feb. 1963 164 p refs *Its* Rept.-1093-13
(Grant NsG-74-60; Contract AF 19(604)-4119)
(NASA-CR-59302) OTS: $5.00 fs; $0.75 mf

The refractive indices n were computed from the maxima and minima of channeled spectra, while the extinction coefficients κ were computed from point-by-point transmission measurements. Through the use of wire grating polarizers, both the ordinary ray and extraordinary ray optical constants of $CaWO_4$ were obtained. Selected representative values of the refractive indices were squared and plotted versus the square of frequency, and a linear relation was obtained. The resulting lines were extrapolated to zero frequency, and the following values were found for the static dielectric constants: MgO; 300°K, $\epsilon_0 = 9.79$; 90°K, $\epsilon_0 = 9.56$; $CaWO_4$: E$\perp$c-axis (ordinary ray). 300°K, $\epsilon_0 = 10.88$; 90°K, $\epsilon_0 = 10.61$; E$\parallel$c-axis (extraordinary ray) 300°K, $\epsilon_0 = 9.16$; 90°K, $\epsilon_0 = 8.92$. The values of the dielectric constant (real part) ϵ' followed the predictions of classical dispersion theory, while the values for the dielectric constant (imaginary part) ϵ'' did not; this finding is in agreement with those of other workers. Author

N64-33695* Stanford U., Calif.
OPTICAL SECOND-HARMONIC GENERATION IN ZnS-CdS AND CdS-CdSe ALLOYS
R. A. Soref and H. W. Moos Repr. from J. Appl. Phys., v. 35, no. 7, Jul. 1964 p 2152-2158
(Grant NsG-331; Contract AF 33(616)-7944)
(ML-1231)

Optical second-harmonic generation has been measured as a function of alloy composition in wurtzite, ZnS-CdS, and CdS-CdSe monocrystals. The relative values of the nonlinear susceptibilities were determined; χ_{33} increased by nearly one order of magnitude as the band gap was decreased from $1.52(2\hbar\omega)$ to $0.73(2\hbar\omega)$. (Because of this strong increase in χ_{33}, appreciable second-harmonic signals were detected in the crystals of the series, which were highly absorbing at the harmonic frequency.) This agreed with the predictions of a quantum-mechanical analysis. Studies of other II-VI and III-V compounds indicated a strong dependence of the second-order susceptibilities upon the band gap. Author

N64-33722 Franklin Inst., Philadelphia, Pa. Research and Development Lab.
RESEARCH IN SURVEYING, MAPPING AND GEODESY APPLICATIONS OF THE MOSSBAUER EFFECT IN PHYSICS, GEODESY, AND RELATED FIELDS
Bogoljub Lalevic and James K. Gleim 31 Jul. 1964 60 p refs
(Contract DA-44-009-ENG-3767)
(I-A2217-6; AD-446652)

Use of the Mössbauer effect for measurement of relative velocities, angular velocity, and position in mechanics and mechanical devices is examined. In solid-state physics, usefulness of the Mössbauer effect in the study of lattice dynamics and internal fields is reviewed. In atomic physics, applications of the Mössbauer effect to Compton scattering, Rayleigh scattering, and Thomson scattering are surveyed. Some aspects of the theory of relativity have been tested by Mössbauer methods and the results presented here. A somewhat more detailed discussion examines the usefulness of Mössbauer methods with respect to gravimetric measurements made by various types of pendulum systems. Also considered are its use in detecting the photon frequency shift in the measurement of the velocity of light, in control of quartz oscillator frequencies for timekeeping, in the measurement of the refractive index of piezocrystals with greater precision than by conventional methods, and in the determination of the dimensional stability of photographic films. Author

N64-33730 Naval Research Lab., Washington, D.C. Solid State Div.
DETECTOR INVESTIGATION FOR 8-15 AND 100-4000 MICRONS REGIONS Semiannual Technical Summary, Period Ending 30 Jun. 1964
R. F. Wallis and H. Shenker Jul. 1964 24 p refs *Its* Rept.-12
(ARPA Order 269-62; Proj. Defender)
(NRL-Memo-1550; AD-444084)

The following work is reported: (1) continued development of a gallium-doped germanium detector whose spectral and photoresponse characteristics are approximately 50% higher than previous detectors; (2) continued testing of neutral dopants to improve the characteristics of doped germanium detectors, particularly zinc and boron dopants; (3) observation of the excited levels of the shallow n-type impurities in InSb in a magnetic field and of the transmission of InSb as a function of magnetic field; and (4) improved materials preparation using a dopant dropping technique. M.P.G.

N64-33749 Radio Corp. of America, Princeton, N.J. RCA Labs.
SYSTEMATIC STUDY OF THE CRYSTAL FIELD OF CaF_2 Final Report, Apr. 1, 1963-Mar. 31, 1964
Herbert A. Weakliem 20 Aug. 1964 42 p refs
(Contract Nonr-4133(00); ARPA Order 306-62; Proj. Defender)
(AD-446246)

Crystals of CaF_2 containing transition metal ions and crystals of CdF_2 containing transition metal and rare-earth ions have been grown, and the spectra were measured. The transition metal ions either are not fluorescent or have only broad fluorescent bands. The ions in the first half of the 3d series prefer the 3+ oxidation state and were found to have large Dq values (1000 to 1500 cm^{-1}), whereas those in the latter half of the series prefer the 2+ oxidation state and have Dq values less than 500 cm^{-1}. The rare-earth ions all go into CdF_2 in the 3+ oxidation state and apparently cannot be reduced to the 2+ state. The absorption and fluorescent spectra of the CdF_2 rare-earth-doped crystals are typical of those seen for rare-earth ions in many other crystals. The linewidths of the narrow fluorescent lines in $CaF_2:Tm^{2+}$ and $CaF_2:Dy^{2+}$ were studied

by conventional spectrographic, interferometric, and optical magnetic resonance methods. Author

N64-33759 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
HOMOGENEITY OF CADMIUM SELENIDE-CADMIUM SULFIDE SOLID SOLUTIONS BY X-RAY FLUORESCENCE
Donald Arthur Brooks (M.S. Thesis) Aug. 1964 108 p refs
(GNE/Phys/64-6; AD-603604)

Both as-grown or assumed homogeneous crystals and purposely manufactured nonhomogeneous crystals were used in this research. The percentage of selenium in the assumed homogeneous crystals was determined to within 1% accuracy by the volumetric analysis of selenium iodometrically. These analyzed crystals were used as standards for the X-ray fluorescence analysis. It was concluded from the X-ray analysis that any results within 3% of each other were due to statistical variations, but results with deviations greater than 3% were due to the composition change within the crystal. The homogeneity of four assumed homogeneous and four nonhomogeneous crystals was examined by scanning the crystals with stationary collimators of small aperture. The assumed homogeneous crystals showed results within 3% and were therefore considered homogeneous, but the purposely manufactured nonhomogeneous crystals were found to be truly nonhomogeneous. Author

N64-33771* General Dynamics/Electronics, Rochester, N.Y.
RESEARCH ON A FERROACOUSTIC INFORMATION STORAGE SYSTEM First Quarterly Report, Jun. 10–Sep. 9, 1964
J. W. Gratian and R. W. Freytag [1964] 40 p refs
(Contract NASw-592)
(NASA-CR-59323) OTS: $2.00 fs; $0.50 mf

Investigation of factors limiting the performance of a nonvolatile, delay-line memory technique is reported. Consideration of planar or strip line configurations, in place of tubular forms, indicates advantages for both near-term approaches using mill-processed media and long-range approaches using thin films. Improved techniques are described for providing more significant quasi-static measurements and analyses of the applicability of isotropic magnetic materials. Changes in media processing are indicated. Advances in procedures and new criteria for evaluating strain-sensitive anisotropic thin films for ferroacoustic storage are reported. Author

N64-33805* General Dynamics/Electronics, Rochester, N.Y. Research Dept.
LASER MODULATION AT THE ATOMIC LEVEL Monthly Report No. 2, 1–31 August 1964
E. G. Brock, F. C. Unterleitner, Y. C. Kiang, and J. F. Stephany
10 Sep. 1964 13 p refs
(Contract NASw-1008)
(NASA-CR-59313) OTS: $1.00 fs; $0.50 mf

The determination of gain in ruby as a function of magnetic field was continued, with some indication of the appreciable influence of excited state absorption upon the measurements. Substitution of YAG:Nd^{3+} for CaF_2:Dy^{2+} as the initial laser material to be studied is suggested. Preparations for the experimental observation of the Zeeman splitting of the laser emission in a homogeneous pulsed field are described. Author

N64-33806* General Dynamics/Electronics, Rochester, N.Y. Research Dept.
LASER MODULATION AT THE ATOMIC LEVEL Monthly Report No. 3, 1 Sep.–30 Sep. 1964
E. G. Brock, F. C. Unterleitner, Y. C. Kiang, and J. F. Stephany
10 Oct. 1964 12 p ref
(Contract NASw-1008)
(NASA-CR-59314) OTS: $1.00 fs; $0.50 mf

The absorption of a ruby rod is described in the presence of absorption by the metastable state in the wavelength region of interest and with some inhomogeneity in pumping along the length of the rod. The results of transmission measurements at room temperature and at 115° K are presented and interpreted by means of the theory. Initial testing of a YAG: Nd^{3+} laser rod is described. Author

N64-33816 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
MAGNETIC PROPERTIES OF RARE EARTH-IRON ALLOYS
Gerald L. Mouton (M.S. Thesis) Aug. 1964 77 p refs
(GNE/Phys/64-12; AD-603612)

Magnetic properties of neodymium–iron, praseodymium–iron, and cerium–iron alloys were measured on small rod samples. Constant temperature plots of magnetization versus field (up to 24 kOe), as well as constant field plots of magnetization versus temperature (4.2° to 375° K), were obtained for the samples. The apparatus provided an accurate and rapid means of obtaining magnetic data. The magnetization value obtained for a pure nickel sample was within 0.5% of published data. The 24 kOe field was not sufficient to reach the saturation magnetization of the rare-earth alloys. Author

N64-33818 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
LENGTH CHANGE MEASUREMENTS OF ELECTRON-IRRADIATED CADMIUM SULFIDE
Ronald Lawrence Bellows (M.S. Thesis) Aug. 1964 75 p refs
(GNE-64; AD-603606)

The relationship between radiation damage in a "thin" platelet, high-purity, single-crystal cadmium sulfide crystal and the change in the physical dimensions of the crystal was investigated. The sample was irradiated in a vacuum at 77° and 300° K by a 150 keV electron beam just above the beam displacement threshold for the sulfur atom of 115 keV. The crystal was initially bombarded at 300° K to 8×10^{18} electrons/cm^2 with a resultant specific length change, $\Delta L/L$, of $(+3.4 \pm 10.0) \times 10^{-23}$ per electron/cm^2, which is within the experimental error and thus considered negligible. This was followed by an irradiation at 77° K of 9×10^{18} electrons/cm^2. In the first 6×10^{18} electrons per cm^2 a shrinkage of the crystal of $(-6 \pm 2) \times 10^{-4}$ cm per cm was observed, after which the curve leveled off with no change in length occurring up to 9×10^{18} electrons per cm^2. Author

N64-33834 New Mexico State U., University Park
THE EFFECTIVE FIELD IN CRYSTALS WITH OVERLAPPING ATOMS
O. Theimer and R. Paul [1964] 22 p refs Partially sponsored by ONR

The polarizing field E^p in a monatomic cubic crystal is calculated. At the center of the atoms the field is presented in the form $E^p = E + (4\pi/3)\gamma_l P$. (E is the average macroscopic field, P is the polarization) and γ_l is calculated for various degrees of overlap between the electron clouds of neighboring atoms. Each atom is characterized by a polarizability density $\alpha_j(r)$, and the crystal by the Fourier transform of polarizability density $\alpha(r) = \Sigma\alpha_j(r)$. In this fashion the inhomogeneity of E^p can be taken into account, and E^p is obtained as an iterative solution of an integro-differential equation that is equivalent to Maxwell's equations for a dielectric medium. The γ_l

is found equal to unity for strongly overlapping atoms and . r point atoms. For intermediate cases γ_j is found to depend on the form of $\alpha_j(r)$. Author

N64-33839 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
CONTROL OF LASER RADIATION WITH BIREFRINGENT CRYSTALS: THE MICROWAVE CIRCUIT VIEWPOINT
M. R. Wohlers and K. G. Leib Jun. 1964 11 p ref
(RM-2345)

Microwave circuit theory is utilized to describe three devices that control coherent optical beams using birefringent crystals. A frequency demodulator uses the difference of the index of refraction along two axes of a birefringent crystal together with a Fabry–Perot interferometer to obtain an s-type frequency discriminator. An optical isolator consists of a crystal and a polarizer functioning in such a way that the input of the device is isolated from the reflection that can occur at its output. An optical switch is based on the filter characteristics of a Fabry–Perot interferometer, which can be adjusted using an electrically activated birefringent crystal. Author

N64-33841 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
MOLECULAR IMPACT STUDIES Annual Report, 15 Jul. 1963–15 Jun. 1964
D. Mc Keown, H. R. Poppa, and M. G. Fox Jul. 1964 61 p refs
(Contract Nonr-3175(00))
(GDA-DBE64-048; AD-445823)

The sputtering of surfaces by atoms, ions, and molecules was investigated. Measurements were conducted in the laboratory using molecular beam techniques at energies ranging up to 1 keV, and in the upper atmosphere from instrumented satellites. Sputtering yields were measured by the quartz-crystal oscillator that had been improved for the purpose by the epitaxial growth of thin-film gold crystals on it. Sputtering results are reported for both single crystal and polycrystalline surfaces. Yield measurements were made in the threshold region on the (111) plane of Au in Ar^+. The effect of surface finish on the yields of polycrystalline Au, Ag, and Cu targets are given. Yield determinations on polycrystalline Ag at normal incidence between 30 eV and 1000 eV in He^+, Ar^+, Ne^+, Kr^+, and Xe^+ are reported. Papers on sputtering in the upper atmosphere and on effects of atomic and molecular impacts on spacecraft are included. D.E.W.

N64-33869* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTRICAL AND INFRARED PROPERTIES OF GLASSES IN THE SYSTEM Bi_2O_3-TeO_2
Donald R. Ulrich 18 Aug. 1964 14 p refs
(NASA-TM-X-53110) OTS: $1.00 fs; $0.50 mf

The region of glass formation in the binary system TeO_2-Bi_2O_3 has been defined. The electrical properties (resistance and capacitance) of these glasses, at room temperature and at liquid nitrogen temperatures, and the infrared transmission spectra have been determined. Author

N64-33872 Harvard U., Cambridge, Mass. Cruft Lab.
MICROWAVE-OPTICAL EXPERIMENTS AND PSEUDO-STARK EFFECTS IN RUBY
Martin Gilbert Cohen 5 Feb. 1964 132 p refs
(Contract Nonr-1866(16); ARPA SD-88)
(TR-437; AD-603649) OTS: $5.00

A quantitative investigation of the absorption among the Zeeman components of the R- and B-lines, and a study on the optical detection of the microwave resonances in the ground state were carried out and are reported. Measurements of the effect of an applied electric field on the R-lines were repeated with improved accuracy, and the influence of an electric field on the B-lines was observed. The results are presented. D.E.W.

N64-33899 Compagnie Generale de Telegraphie sans Fil, Putevux (France)
STUDY OF SPECIAL LITHIUM BASED AND NICKEL BASED FERRITES IN VIEW OF THE REALIZATION OF HIGH $H\mu Q$ PRODUCTS FOR THE FREQUENCY RANGE FROM 30 TO 200 MC/S Final Report
A. Vassiliev Jul. 1963 177 p
(Contract DA-91-591-EUC-2591)
(AD-422698)

A study was conducted of the influence of a few factors that act on the physical processes determining initial permeability in nickel- or lithium-based ferrites. The principal factors considered were the saturation moment, the anisotropic field, resistivity, and grain size. The results obtained include the following: (1) The reduction of the magnetic moment appears as a variation of μ' at low frequency, and affects the lower frequency at which magnetic losses occur and the behavior of the product μQ at high frequencies. (2) Addition of cobalt ions also produces important and useful effects. (3) Influence of heat treatment on grain size is made apparent, as are the effects on initial permeability. D.S.G.

N64-33921* North American Aviation, Inc., Canoga Park, Calif.
INVESTIGATION OF CURRENT DEGRADATION PHENOMENON IN SUPERCONDUCTING SOLENOIDS Summary Report, Jun. 1963–May 1964
L. C. Salter, Jr. Huntsville, Ala., NASA, Marshall Space Flight Center [1964] 46 p refs
(Contract NAS8-5356)
(NASA-CR-59369; AI-64-198) OTS: $2.00 fs; $0.50 mf

Critical currents of unplated 0.025-cm-diam Nb-25%Zr wire are found to depend on the center-to-center spacing of the wires and on the number of layers of solenoid winding. For copper-plated 0.025-cm diam Nb-Zr wires, solenoid critical currents are found to be given by $I = I_1 \log l + I_2$, where l is the wire length. Solenoid currents can be predicted to better than ± 10% for both classes of wires. Experiments with various diameter Nb-33%Zr wires show that for copper-plated and unplated wires both solenoid and short sample critical currents decrease with increasing diameter. Degradation also increases with diameter. The effects of mechanical constraint and thermal environment are minor. The SN transition investigations show that the normal transition originates in the highest field region in the experimental solenoid and propagates predominantly by a process other than joule heating. Author

N64-33925 American Optical Co., Southbridge, Mass. Research Center
NEODYMIUM LASER GLASS IMPROVEMENT PROGRAM Technical Summary Report, 30 Jun. 1963–30 Jun. 1964
Richard F. Woodcock Sep. 1964 24 p refs
(Contract Nonr-3835(00); ARPA Order 306-64; Proj. Defender)
(TSR-4; AD-605517)

Investigations were carried out in the areas of laser glass compositions that are nonsolarizing, of the effect of host glass composition on fluorescent lifetime, of analysis of the fluorescent decay curve, and of laser threshold studies. D.E.W.

N64-33940 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF THE PROPERTIES OF A POLYMER-SEMICONDUCTOR INTERFACE

G. A. Sokolina, N. A. Krotova, and Yu. A. Khrustalev 9 Sep. 1964 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 147, no. 6, 1962 p 1409–1412
(FTD-TT-64-467/1+2; AD-606480)

Germanium crystals of the n type were studied for the effects of coating with polymers by the field-effect method. Experiments with some commercial lacquers show that their application to the surface of a semiconductor leads to considerable changes in the surface state, changing its charge and introducing a large number of surface states. D.E.W.

N64-33944 Technical Research Group, Inc., Melville, N.Y.
RESEARCH ON PROPERTIES OF LASER DEVICES Ninth Quarterly Technical Summary Report, 1 Jun.–31 Aug. 1964
R. Kaplan, ed. [1964] 49 p refs
(Contract AF 49(638)-673; ARPA Order 256-62; Proj. Defender)
(TRG-134-QTR-9; AD-447907)

Apparatus has been completed for testing the principle of relaxation of the lower laser level in a gas discharge by inelastic atom-atom collisions. An alumina tube for containing a manganese–noble gas mixture at 1350° C has been rebuilt. He-Xe test oscillations have been generated in this tube at 1350° C. A resistance-heated tantalum tube for containing a lanthanum–noble gas mixture at 1800° C has been completed. A discharge current density of 0.5 A/cm^2 has been achieved between this tube and a concentric tungsten filament over a length of 10 cm. Further progress has been made in the investigation of improvements in energy radiance that can be achieved by mode selection in a ruby cavity. An accurate technique for measuring pulse energy per unit solid angle has been established. Author

N64-33945 Raytheon Co., Waltham, Mass. Research Div.
SINGLE CRYSTAL HEXAGONAL FERRITES Fourth Quarterly Progress Report, Jan. 15–May 31, 1964
J. Van Hook and S. Cvikevich [1964] 33 p refs *Its* Rept.-4
(Contract DA-36-039-AMC-00096(E))
(S-658; AD-605829)

Single crystals of ZnY and ZnY with additions of MnO_2 have been grown from barium borate melts. Chemical composition, saturation magnetization, lattice parameter, and resonance linewidth were measured on single and polycrystalline samples of these materials. Substitution of manganese materially improves the resonance linewidth of ZnY. Typical linewidth values at 9.2 Gc for spheres of pure ZnY were 50 Oe, whereas corresponding values on ZnY crystals containing manganese, produced under identical conditions, were of the order of 10 Oe. Author

N64-33955 General Electric Co., Schenectady, N.Y.
DEFORMATION MECHANISMS OF REFRACTORY AND OTHER MATERIALS Final Technical Report, 1 Nov. 1963–30 Apr. 1964
W. G. Johnston and J. S. Nadeau Wright-Patterson AFB, Ohio, ARL, Aug. 1964 55 p refs
(Contract AF 33(616)-7942)
(ARL-64-135; AD-436157) OTS: $1.50

An experimental study of the dynamical flow properties of Al_2O_3 single crystals at elevated temperatures, and several aspects of deformation behavior of other nonmetallic crystals, principally MgO and alkali halides, are reviewed. The qualitative aspects of deformation behavior are compared, as well as dislocation velocity measurements, strain rate sensitivity, and yield point phenomena in various materials. The flow stress of pure and doped alkali halides is investigated in the temperature range of 20.5° to 300° K. Most of the work with doped crystals has been in crystals of NaCl and LiF containing divalent impurities present and impurity-vacancy pairs. The flow stress at low temperature (20.5° K) is compared with Fleischer's theory of hardening by defects that produce tetragonal distortions. The effect of heat treatment on doped crystals is described, as well as the effect of OH^- or F^- ions in NaCl doped with divalent metal impurities. Author

N64-33996 Joint Publications Research Service, Washington, D.C.
EXCITED RADIATION OF SEMI-CONDUCTOR ARSENIC GALLIUM
Wang Nai-Hung, P'an Chun-hua, Nieh Chai-Chiang, and Liu Hsun-Ko *In its* Transl. on Communist China's Sci. and Technol. 26 Oct. 1964 3 p (See N64-33995 24-07) OTS: $3.00

The excited illumination of a semiconductor arsenic p-n junction was investigated. The excited light is emitted from the two polished parallel ends of the arsenic gallium p-n junction. A monochromatic light meter was used to measure the radiating wavelength and the half-width of the spectral line. Below the threshold current (25 amp) the incoherent spectral width is 200 Å; above the threshold current the measured spectral width is 20 Å. A checked photocell was used to measure the peak power of the excited pulse, and it was found that the power was 0.5 watt when the width of the pulse is 3μsec, and 4 watts when the width of the pulse is 0.3μsec. P.V.E.

N64-34004* Harshaw Chemical Co., Cleveland, Ohio Crystal-Solid-State Div.
RESEARCH AND DEVELOPMENT IN CdS PHOTOVOLTAIC FILM CELLS First Quarterly Report, May 19–Aug. 19, 1964
T. A. Griffin, R. W. Olmsted, and J. C. Schaefer [1964] 29 p refs
(Contract NAS3-4177)
(NASA-CR-54173) OTS: $2.00 fs; $0.50 mf

Significant improvements reported in CdS thin-film cell development for space applications include the following: (1) lighter substrates yielding over 40 watts/lb on 3-in. by 3-in. cells; (2) electroplated grids with an efficiency of 3%, indicating the possibility of eliminating the costly gold electroformed mesh; and (3) a new cell packaging design that has withstood hundreds of thermal cycles between + 65° C and − 70° C in vacuum. M.P.G.

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-32797 Witwatersrand U., Johannesburg (Union of South Africa)
THE DETERMINATION OF LAMINAR BURNING VELOCITY WITH PARTICULAR REFERENCE TO THE CONSTANT VOLUME METHOD. PART I: THEORY
C. J. Rallis Jul. 1964 51 p refs
(Rept.-20)

The theory of the method is examined and shown to be essentially simple. Two basic forms of burning velocity equations are derived, in terms of the properties of the unburnt and burnt gas, respectively. A so-called combined form that has important practical advantages is also developed. Various corroborative relations are presented. Equations relating local and mean values of pressure, temperature, and density are derived. These suggest a direct method whereby both gas properties and burning velocities may be determined. Author

N64-32841* National Aeronautics and Space Administration, Washington, D.C.
GASDYNAMICS OF COMBUSTION
K. I. Shchelkin and Ya. K. Troshin Oct. 1964 370 p refs Transl. into ENGLISH of the book "Gazodinamika Goreniya" Moscow, Izd. Akad. Nauk SSSR, 1963
(NASA-TT-F-231) OTS: $5.00

This article pertains to the theoretical conclusions and their applications to combustion in jet or rocket engines. It contains investigations of instability conditions of plane detonation and a description of spin and pulsating detonation waves. Deflagration and normal and turbulent combustion as basic forms of flame propagation are analyzed. The propagation of double discontinuities as permitted by the laws of gasdynamics and thermodynamics is considered, and crude acceleration criteria for the acceleration of turbulent flames in tubes are obtained. The relationship of the flame acceleration in gases to the movement of the unburned gas in the tube is investigated and an attempt is made to obtain high-frequency vibrations in forced combustion chambers by problem solving through acoustic approximations. G.G.

N64-32930 Naval Radiological Defense Lab., San Francisco, Calif.
IGNITION-ABLATION RESPONSES OF CELLULOSIC MATERIALS TO HIGH RADIANT HEAT LOADS
Stanley B. Martin [1964] 12 p refs Presented at the 1964 Spring Meeting, Western States Sect., The Combust. Inst., Stanford U., Apr. 1964
(WSS/CI Paper-64-8; AD-449601)

Radiant exposure values are reported for persistent-flaming ignition of black α-cellulose exposed to constant-irradiance, thermal inputs of 30 msec duration and longer. The radiant exposure values are shown to be approximately proportional to the thickness of the exposed material and not strongly dependent on exposure duration for pulses this brief. The significance of sustained flaming ignition, relative to ablation effects, for pulses of very brief duration is discussed. Author

N64-32958 Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Research Div.
FURTHER DEVELOPMENT OF CONFORMAL MAPPING TECHNIQUES
Eric B. Becker, Howard B. Wilson, Jr., and Charles H. Parr 31 Jul. 1964 54 p refs
(Contract DA-01-021-ORD-11878(Z))
(S-46; AD-447289)

A significant improvement in the previously reported method of conformally mapping singly connected regions having at least one axis of symmetry was achieved. In addition, the method was extended to include mapping of interior regions. The method was tested by conformally mapping several solid-propellant-grain cross sections, a splined shaft, and notches in and a protrusion on a half plane. Listings of and operating procedures for the pertinent computer programs written in FORTRAN IV are given. Author

N64-32959 Rocketdyne, Canoga Park, Calif.
STUDY OF AN ENDOTHERMIC FUEL FOR THE ATLAS ROCKET MOTOR First Quarterly Progress Report, Period Ending 31 Aug. 1964
W. S. Hines, J. D. Seader, and J. G. Gerstley 16 Sep. 1964 49 p refs
(Contract AF 04(611)-9721)
(RM-1084/362; AD-448294)

The analytical studies examined the use of tetraisobutylene (TIB) as a replacement for RP-1 in an Atlas type engine with FLOX as the oxidizer. Performances of the two fuels were compared, as well as the coolant jacket pressure drops and coolant temperature rises. Assumptions of varying amounts of gas-side carbon deposition were made. Because of its inferior transport properties, TIB appeared to be an inferior coolant to RP-1 under conditions where its greater heat sink was not required. The experimental effort was directed toward the preparation of an apparatus to perform forced-convection heat transfer studies with TIB. An existing closed-loop hydrocarbon flow system was rebuilt, and a flow bench and tubular test sections were constructed. Author

N64-33005 Arizona U., Tucson
THE USE OF GAS-SOLID AND GAS-LIQUID CHROMATOGRAPHY IN COMBUSTION GAS ANALYSIS
Jose J. Olvera (M.S. Thesis) 1964 70 p refs
(AD-602228) OTS: $3.00

By extensive calibration of the gas chromatography apparatus and by the construction of a sampling apparatus, combustion products from a combustion tunnel were analyzed, and air-fuel ratios were calculated. The procedure employed was to use known mixtures of pure gases and to record on an electronic recorder the response of the gas chromatography apparatus. Gases used in the calibrating mixtures were H_2, O_2, N_2, CH_4, CO_2, and CO. Author

N64-33071 McGill U., Montreal (Canada) Mechanical Engineering Research Labs.
SPARK IGNITION OF A MIXTURE OF HELIUM AND STOICHIOMETRIC OXYGEN-HYDROGEN
A. H. Cohen Aug. 1964 82 p refs
(Rept.-64-12)

A series of combustion tests have been performed to investigate the possibility of developing an internal spark ignition system for use in hypersonic shock tunnels. Stoichiometric oxygen-hydrogen mixed with different amounts of helium made up the combustible charge. The electrode configurations were of the spherical-spherical or point-plane type. The parameters of the experiment were as follows: (1) loading pressure 500, 800, 1200, and 2000 psia; (2) percentage helium 65%, 70%, 75%, and 80%; and (3) electrode gap spacing 0.002 to 0.010 inch. Author

N64-33076* Technidyne Inc., West Chester, Pa.
GELLING OF LIQUID HYDROGEN Final Report
Herbert Kartluke, C. Dana Mc Kinney, Richard Pheasant, and William B. Tarpley 31 Jul. 1964 58 p refs Prepared jointly with Marquardt Corp.
(Contract NAS3-2568)
(NASA-CR-54055; RR-64-47) OTS: $3.00 fs; $0.75 mf

The most effective commercially available particulate gellant, pyrogenic silica (in the finest particle size, 7 mμ) formed gels in LH_2 at a loading of 35 to 37 wt.%. A search for high-energy, low-density solid fuels that might be preparable in the ultrafine particle size requisite for gelation revealed, for example, lithium borohydride ($LiBH_4$, 0.66 g/cm^3). Calculations, without optimization, have shown that, even with as much as 20 wt.% of $LiBH_4$ loading, LH_2 performance degradation with lox would amount to only 4.5%, or with LF_2 only 2.5%. Preliminary preparations of fuel-gellants were made for screening purposes, although the particle sizes were larger than optimal. LH_2 gels were made as follows: lithium borohydride 67 wt.%, and lithium aluminum hydride 86 wt.%. Other candidate fuel-gellants that were briefly examined and appear promising include boron, boranes, methane (in situ), hydrazine, and certain light metal hydrides. The ultimate choice depends

on such factors as low density, high energy contribution, and ease of preparation of particles in sizes below 50 mμ. Author

N64-33273 Colorado School of Mines, Golden
EXPERIMENTAL DETERMINATION OF MECHANICAL RESPONSE OF SOLID ROCKET PROPELLANT UNDER HIGH STRAIN RATE AND LOW TEMPERATURE Final Report
Richard S. Culver and John S. Rinehart 15 Jul. 1964 44 p
(Grant Nonr-3774(00)(FMB))
(MRL-ONR-3; AD-603871)

Described in this report are the results of an experimental investigation of the mechanical properties of two simulated solid rocket propellants. The "green" propellant is salt-filled polyurethane; the "gray" propellant is Adiprene L-100, filled with aluminum powder, aluminum sulphate, and castor oil. In low temperature tests the expected inverse relation between temperature and U.T.S. was found. In static torsion tests, the gray propellant exhibited a marked notch sensitivity and a tensile fracture mode, while the green had no notch sensitivity and a shear fracture mode. The impulsive fracture strength of the green propellant was found to be about 16 000 psi, in confirmation of tests run by previous investigators, and the shock attenuation at this stress level is about 5000 psi/in. An approximate value of 24 000 psi for the impulsive fracture strength of the gray was obtained by indirect means, along with a shock attenuation of 1500 psi/in. Author

N64-33304 Phillips Petroleum Co., Bartlesville, Okla.
THERMAL STABILITY OF HYDROCARBON FUELS Technical Documentary Report, Jun. 1, 1963–May 31, 1964
Lucien Bagnetto and Harold T. Quigg Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 21 Aug. 1964 175 p refs
(Contract AF 33(657)-10639)
(APL-TDR-64-89, Pt. I; AD-606959)

A 5-ml-bomb test method was modified to improve its ability to measure small differences in thermal stability quality of fuels. This test method is based upon the loss in uv-light transmittance experienced when a 5-ml sample of the fuel is heated to a given temperature for 20 minutes. A threshold failure temperature for a given fuel is determined by heating the bomb over a range of temperatures to establish the level of heating required to produce an arbitrary loss of 25 units in light transmittance at 350μ wavelength. Several procedures were evaluated for accelerating the aging of fuels as possible test methods for predicting deterioration in thermal stability during storage. Procedures such as thermal stressing, ultraviolet irradiation, chemical initiation, and iron oxide catalysis showed accelerated aging effects for a variety of fuels, as measured by deterioration in uv-light transmittance. Author

N64-33324 California Inst. of Tech., Pasadena W. M. Keck Lab. of Engineering Materials
A RESEARCH PROGRAM ON SOLID PROPELLANT PHYSICAL BEHAVIOR Quarterly Report No. 1, 1 Nov. 1963–31 Jan. 1964
M. L. Williams Feb. 1964 8 p refs
(Contract AF 04(611)-9572)
(MATSCIT-PS-64-1; AD-602754)

This integrated program applies to research in the physical behavior of solid propellants for solid rocket motors. The following studies are proposed and outlined: Behavior of Polymeric and Composite Systems; Standardized Material Characterization; Data Information Facility; and Distribution of the Library Additions List. G.G.

N64-33413 Dow Chemical Co., Midland, Mich. ARPA Lab.
MASS SPECTRAL STUDIES BEHIND SHOCK WAVES. II: THE THERMAL DECOMPOSITION OF HYDRAZINE
R. W. Diesen Aug. 1963 23 p refs Submitted for Publication
(Contract Nonr-3814-(00))
(AR-3S-63; AD-414909)

The decomposition of hydrazine, diluted in argon, has been studied over the temperature range 1200° to 2500° K and pressure range 0.04 to 0.25 atm using a shock tube coupled to a time-of-flight mass spectrometer. The time-resolved mass spectra (25μsec) enable the simultaneous identification and determination of N_2H_4, NH_3, N_2, H_2, and the NH_2 radical, the five major species observed. The material balance is within the experimental error (10%) during reaction up to complete decomposition. Author

N64-33500 Naval Radiological Defense Lab., San Francisco, Calif.
FLASH PYROLYSIS OF SOLID-FUEL MATERIALS BY THERMAL RADIATION
Kenneth A. Lincoln [1964] 21 p refs Presented at the Spring Meeting, Western States Section, The Combustion Inst., Stanford U., Calif., Apr. 1964
(WSS/CI Paper-64-6; AD-449602)

It is important to determine the preignition thermal decomposition behavior of solid fuel. The chief endeavor has been to study the pyrolysis products (both volatile and nonvolatile) of this process, with emphasis on identifying and measuring the volatiles produced under various rates of heating carried out in vacuo or in an inert atmosphere. Attention has been directed toward the thermal decomposition of cellulosic materials, and the results show that the rate of heating plays significant role. The amount and kinds of volatiles produced by flash heating differ markedly from those resulting from slower heating. Author

N64-33510 Israel Program for Scientific Translations, Ltd., Jerusalem
THE PHYSICS OF COMBUSTION AND EXPLOSION
L. N. Khitrin 1962 455 p refs Transl. into ENGLISH of the book "Fizika Goreniya i Vzryva" Moscow, Izd. Mosk. Univ., 1957 Published for NSF and the Dept. of Comm.
(IPST-640; OTS-61-31205) OTS: $4.50

This manual of modern principles of the theory of combustion processes covers the following topics: chemical kinetics, ignition processes, normal flame propagation and combustion, detonation and the flame-propagation process, combustion problems in internal combustion engines and gas burners, combustion of liquid and solid mixtures, burning of liquid fuels, burning of solid fuel, burning velocity of coal, burning of aggregates of particles, and ignition of carbon (coke). M.P.G.

N64-33573 IIT Research Inst., Chicago, Ill.
A STUDY OF THE FUNDAMENTALS OF LIQUID PROPELLANT SENSITIVITY Third Technical Progress Report
Ted A. Erikson Edwards AFB, Calif., AF Flight Test Center, 15 Jul. 1964 27 p refs
(Contract AF 04(611)-9566)
(IITRI-C6024-12; AD-445350)

Shock-tube tests with approximately 0.1 g samples of Compound R at initial temperatures near −180° C were performed with measured induction times of 0 to 1 msec; a 400μsec time delay from shock reflection to detonation was measured for six identical tests at an incident nitrogen shock near Mach 2.4 with less than 10μsec deviation. The initial mode of initiation by the shock-tube test is either energy

transfer to, or heterogeneous attack at, the surface of the condensed phase. Increased gas temperature will increase the initial energy flux but decrease the rate of heterogeneous attack. The maximum energy accumulation during the conditions for the 40μsec delay time by energy transfer is 8.33 cal/cm^2. Assuming a 10 kcal/mole heat of heterogeneous reaction, the corresponding energy accumulation is 30 cal/cm^2. Author

N64-33648 Atlantic Research Corp., Alexandria, Va. Kinetics and Combustion Div.
RESEARCH DIRECTED TOWARD THE DEVELOPMENT OF A COMBUSTIBLE MIXTURE CONTAINING BARIUM Final Report
A. Macek, R. Friedman, and J. A. Simmons 15 Aug. 1964 39 p refs
(Contract AF 19(628)-3899)
(AFCRL-64-675; AD-449508)

The combustion system consists of tetracyanoethylene, hexanitroethane, and barium peroxide. In a series of machine computations, a mixture containing 8% BaO_2 by weight was found suitable for experimental work. The calculated extent of ionization of barium is 7.9% at the adiabatic flame temperature of 3780° K and 2.2% at the experimental temperature of 3310° K. The mixture was prepared and pressed into strands of 1.65 gm/cc density; its stability, sensitivity, and burning rate were studied. Flame spectrometry of the mixture yields line-intensity flame temperature of 3310 ±50° K, and line reversal temperature somewhat above 3080° K. The experimental extent of ionization of barium, determined by the relative intensities of the Ba^+ and Ba^0 lines, is 9%. Author

N64-33829 Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
HYDROGEN SAFETY Progress Report, Jul. 1–Sep. 30, 1964
R. A. Van Meter, I. Liebman, E. L. Litchfield, and M. G. Zabetakis Oct. 1964 35 p refs
(PR-3)

Existing practices are reviewed; areas requiring the development of new information are delineated; and a safety manual is being compiled, based on fundamentals and applicable to a broad group of operations involving hydrogen. Current progress is reported on a literature survey of hydrogen safety practices, on an evaluation of some commercial hydrogen-leak detectors, and on a investigation of modes of the combustion of hydrogen. D.E.W.

N64-33849 Phillips Petroleum Co., Bartlesville, Okla. Research Div.
EFFECT OF JP-5 PROPERTIES ON HOT GAS CORROSION AND FLAME RADIATION
R. M. Schirmer and E. W. Aldrich Jun. 1964 111 p refs
(Contract NOw-63-0406-d)
(RDR-3753-64R; AD-603650)

This report summarizes results of hydrocarbon fuel performance studies. The primary effort was an experimental investigation to determine whether the maximum sulfur content of 0.4 wt.%, currently allowed in grade JP-5 aviation turbine fuel, is a safe level for protection of the superalloys used in high-performance engines when operated in a marine environment. A second phase dealt with the effect of fuel molecular structure and volatility on the total radiant energy from combustor flames, which by contributing to the operating temperature of hot section components, limits aircraft turbine engine power and durability. Author

N64-33874 General Dynamics/Astronautics, San Diego, Calif.
EFFECT ON LAUNCH PROBABILITY DUE TO 30% FLOX IN ATLAS
20 Oct. 1964 21 p ref
(GD/A-DDB-64-024)

The most serious release mode of fluorine into the atmosphere during the FLOX-Atlas operation were analyzed under the most unfavorable atmospheric conditions. It was found that no constraint due to toxicity would be imposed on launch operations. Toxicity limits, release modes, launch and static firings, storage-tank dump, transfer line break, and destruct were considered. P.V.E.

N64-33885 General Electric Co., Cincinnati, Ohio Missile and Space Div.
EFFECT OF IMPURITIES OF CESIUM FUEL UPON ION ENGINES Technical Documentary Report, 1 Jun. 1963–31 May 1964
B. A. Free Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jun. 1964 120 p refs
(Contract AF 33(657)-9163)
(ASD-TDR-63-476, Pt. II; AD-603631)

This report deals with the effect of selected contaminants on the ionization behavior of cesium flowing through a porous tungsten surface. The measurement criterion is critical temperature, where the degree of ionization abruptly rises from a negligible level to a value approaching 100%. The impurities studied are sodium, potassium, and oxygen, all at the 0.3% levels. The effect of sodium and potassium is to raise the critical temperature, whereas oxygen has no effect. Flow rate studies over a limited range have shown that critical temperature is adversely affected by increased flow. An attempt to cancel the adverse effect of the alkali metal impurities by controlled oxygen addition indicated some success, but the effect observed may be within the limits of experimental error. Author

N64-33889 Lehigh U., Bethlehem, Pa. Fritz Engineering Lab.
WELDED CONTINUOUS FRAMES AND THEIR COMPONENTS. THE ULTIMATE STRENGTH OF SINGLE-STORY FRAMES
Joseph A. Yura and Theodore V. Galambos Jul. 1964 42 p refs
(Contract NObsr-90041)
(Rept.-273.18; AD-603676)

The ultimate strength of single-story, pinned-base rigid frames subjected to vertical and horizontal loads is solved. Interaction curves between the axial load and the horizontal load are developed for a column $L/r = 40$. Inelastic behavior and residual stresses are considered. Equilibrium of the deflected structure is considered so that the $P - \Delta$ effect (the additional moments caused by the deflection Δ at the column tops and the axial load in the columns) is investigated. The structural behavior of the structure is discussed, as well as the effect of variation of column slenderness ratios. Author

N64-33896 Sheffield U. (Gt. Brit.)
A STUDY OF THE ACOUSTIC PROPERTIES OF SOLID FUEL ROCKET PROPELLANTS Progress Report No. 1
J. D. Willis [1964] 14 p refs
(Contract MOA-PD/31/014/RI)
(FTCE/41/3/64; HIC-38)

The acoustic properties of solid-propellant rocket fuels are studied in order to determine some way of using the propellant

to damp out the acoustic waves that develop in the combustion system. Two methods are proposed, one involving additives that damp sound waves, and the other being the choice of propellant elasticity so as to damp out the unwanted vibrations. Previous work is reviewed, and a pulse technique for measurement of sound velocity in solids is described. D.E.W.

N64-33929 Bureau of Mines, Pittsburgh, Pa. Explosive Research Center
FUNDAMENTALS OF INITIATION OF DETONATION Quarterly Report, May 1–Jul. 31, 1964
F. C. Gibson, R. W. Watson, J. E. Hay, C. R. Summers, and F. H. Scott 8 Oct. 1964 26 p refs
(ARPA Order 44)
(QR-2; AD-450690)

During the reporting period, the microjet impact work was extended to cover jet impacts on Plexiglas, magnesium, and aluminum. In these experiments, the minimum striking velocities required to produce an impact explosion were determined. These data are interpreted in terms of the shock pressures developed at impact and are compared with the results of previous studies. An investigation of the explosive system nitromethane–tetranitromethane (NM–TNM) was also carried out in an effort to establish a correlation between certain physicochemical properties and detonation behavior as the composition was varied. D.E.W.

N64-33967 Naval Ordnance Lab., White Oak, Md.
TRANSITION FROM SLOW BURNING TO DETONATION: ROLE OF CONFINEMENT PRESSURE LOADING, AND SHOCK SENSITIVITY
Donna Price, J. F. Wehner, and G. E. Roberson 14 Sep. 1964 45 p refs
(NOLTR-64-138; AD-449749)

Use of a high-speed framing camera, as well as ionization probes and strain gages, in the Maček DDT experiment, has produced quantitative information about the transition phenomena. It is shown that inertia of the containing walls plays a large part in the confinement of the burning pentolite. Thus, no wall motion can be detected photographically for about 30μsec after a pressure of one kbar is reached in the burning area. When wall motion does occur, it is at a radial velocity of 0.23 mm/μsec or less, and results in a ballooning and pressure rupture of the tube; maximum distortion is about 8 mm from the ignition point. Plastic deformation of the tube up to a radial increase of 2 mm appears symmetric, and rupture does not occur until after steady-state detonation has been established 90 to 140 mm beyond the point of ignition. The critical pressure for initiation of detonation appears to be reached in the burning area prior to rupture. Author

N64-33971 Douglas Aircraft Co., Newport Beach, Calif. Astropower Lab.
SOLUTION AND CONDUCTIVITY STUDIES IN FLUORINE-CONTAINING LIQUID OXIDIZERS Quarterly Progress Report, 15 Jun.–15 Sep. 1964
M. S. Toy, W. A. Cannon, and W. D. English Oct. 1964 64 p refs
(Contract DA-31-124-ARO(D)-115; ARPA Order 470)
(Rept.-144-QR; AD-450427)

Tetrafluorohydrazine was purified by a low-temperature fractionation column and analyzed by gas chromatography and an infrared spectrophotometer before and after fractionation. Infrared spectra of other oxidizers were also reported. Unsuccessful attempts were made to study ultraviolet absorption of tetrafluorohydrazine in solvents. Conductivity and miscibility studies, photolysis, and temperature effects on conductivities of oxidizers were continued. Author

N64-33978 Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
FUNDAMENTALS OF INITIATION OF DETONATION First Quarterly Report, 1 Feb.–30 Apr. 1964
F. C. Gibson, R. W. Watson, J. E. Hay, C. R. Summers, and F. H. Scott 23 Jun. 1964 25 p refs
(BuWEPS Order 19-64-8047-WEPS)
(AD-443796)

The effect of varying the shock stimulus over a relatively wide range on the delay to initiation and run-up distances for stable low-velocity detonations was studied using nitroglycerin–ethylene glycol dinitrate (NG-EGDN). Other explosive systems, nitrobenzene–white fuming nitric acid (NB-WFNA) and nitromethane (NM), were examined in an attempt to correlate low-velocity detonations with the physicochemical properties of liquid materials that can be conveniently altered. The role of the container in providing rarefaction waves ahead of the reaction zone was more extensively investigated using a pressure sensor technique. The scatter in data and the inconclusive results obtained are attributed to instabilities that are inherent in the LVD process. D.E.W.

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-32722* Hughes Research Labs., Malibu, Calif.
LIFE PHENOMENA IN CESIUM CONTACT ION ENGINES
J. R. Anderson, S. A. Thompson, and H. J. King N. Y., AIAA [1964] 38 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(Contract NAS3-4108)
(AIAA Paper-64-685) AIAA: $0.50 members; $1.00 nonmembers

Charge exchange erosion is believed to form the principal fundamental limitation to ion engine lifetime. Although experimental results as well as complete calculations indicate attainable lifetimes of 3000 to 20000 hours at 10 mA/cm^2 using the "best" present day commercial ionizers, shorter lifetimes result because of the emergence of interrelated secondary physical phenomena within the acceleration region of the engine. Cesium ionization on the focus electrode and insulator leakage are considered in detail since they comprise the immediate barrier to longer operating lifetimes. Constraining surface ionization at the focus electrode to the level of that resulting from charge exchange provides boundary conditions for ionizer efficiency, focus temperature, focus ion current, etc., to assure a given lifetime. The effect of focus electrode roughness on accel erosion patterns has been studied in detail and used to help predict the erosion resulting from charge exchange ions. Author

N64-32723* Hughes Research Labs., Malibu, Calif.
CHARACTERISTICS OF POROUS TUNGSTEN IONIZERS
O. K. Husmann and R. Turk N.Y., AIAA [1964] 30 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.-2 Sep. 1964
(Contract NAS3-4110)
(AIAA Paper-64-691) AIAA: $0.50 members; $1.00 nonmembers

An important characteristic of an electric propulsion system is its total efficiency—the product of power and ionization

efficiency. A total efficiency of over 90% is desirable, and for surface ionization engines, this means neutral efflux must be minimized. High pore densities effect fuel economy and reduce electrode erosion; however, high pore density and long-term sintering stability of porous tungsten are mutually exclusive. Ionizer sintering during engine operation (operation times of over one year are considered) increases the neutral flux. In order to optimize the sintered structure, sintering characteristics of narrow size fractions of spherical tungsten powder have been studied at temperatures of 1770° to 2570°K. The structural stability improves with grain size. Current densities exceeding 10 mA/cm^2 and clean surface conditions are essential to reduce radiation losses. Neutral flux and critical temperature measurements up to 25 mA/cm^2 are reported. Author

N64-32724* Hughes Research Labs., Malibu, Calif.
THE INFLUENCE OF THE RESIDUAL GAS ATMOSPHERE IN SPACE CHAMBERS ON THE NEUTRAL EFFLUX AND CRITICAL TEMPERATURE OF TUNGSTEN IONIZERS
O. K. Husmann, D. M. Jamba, and D. R. Denison N.Y., AIAA [1964] 49 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.-2 Sep. 1964
(Contracts NAS5-517; NAS3-4110)
(AIAA Paper-64-693) AIAA: $0.50 members; $1.00 nonmembers

Investigated were changes in work function and critical temperature for cesium ionization caused by hydrocarbons and oxygen; these data are compared with measurements under clean surface conditions in an ultrahigh vacuum system. In addition, an ultrahigh vacuum system has been used for a detailed study of surface effects caused by individual hydrocarbons with mass numbers ranging between 16 and 128; this range is in accordance with the residual-gas atomic-mass-number range measured in the space chambers. Measurements indicate that a cryopumped space chamber with one of the liners at 22°K, combined with an ion pump, can be equivalent to an ultrahigh vacuum system. Small amounts of hydrocarbons as well as carbon monoxide and carbon dioxide reduce the work function and increase the critical temperature for surface ionization. Experiments with individual hydrocarbons confirmed that excessive amounts of hydrocarbons deposit pyrolytic graphite on the ionizer surface, which results in a greater critical temperature than that of clean tungsten. Author

N64-32725* Hughes Research Labs., Malibu, Calif.
DESIGN CRITERIA AND PERFORMANCE OF A LONG LIFE CONTACT ION ENGINE
George R. Brewer, R. L. Zimmerman, D. Berman, and H. J. King N.Y., AIAA [1964] 56 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.-2 Sep. 1964
(Contract NAS3-4109)
(AIAA Paper-64-710) AIAA: $0.50 members; $1.00 nonmembers

This paper presents the status of the development of a linear strip ion engine designed to produce 15 to 22 mlb of thrust at a current density of 15 mA/cm^2. The primary emphasis is on the techniques of design and construction necessary to assure long life (one year) operation. Two classes of engines are described. The distinguishing feature between these engines is the means of controlling spurious ion emission from the surface of the focus electrode. The results of electrode simulation experiments, comparing engine electrode systems for temperature and material dependence of focus electrode ion emission, accel electrode sputtering, and effects of the sputtered accel material are discussed. Author

N64-32858* Electro-Optical Systems, Inc., Pasadena, Calif.
FOLLOW-ON INVESTIGATION OF A STEADY STATE HALL CURRENT ACCELERATOR Final Report
G. L. Cann and R. L. Harder 30 Oct. 1964 108 p refs
(Contract NAS3-3568)
(NASA-CR-54062; EOS-4010-Final) OTS: $4.00 ft; $0.50 mf

This report describes a high specific impulse and high efficiency plasma accelerator. The device utilizes Hall currents in a jet to accelerate the plasma. It can be operated over a wide range of parameters, and with several different propellants. A model of the electromagnetic interaction with the plasma is postulated. Several models of the accelerator have been tested. A high-power water-cooled engine operated over a power range of 30 to 300 kW. Specific impulses of from 1000 to 10 000 sec at thrust efficiencies of 20% to 45% were obtained using hydrogen as the propellant. A specific impulse of 4000 sec at an efficiency of 25% was obtained using argon. In the same engine, nitrogen was run at a specific impulse of about 1700 sec and an efficiency of 22%. A low power engine was run in which the electrodes were cooled by radiation and regeneration. Specific impulses of 2000 to 4000 sec at efficiencies from 20% to 40% were obtained. Author

N64-32873* California U., Berkeley
SIGNIFICANCE OF DETONATION STUDY TO PROPULSION DYNAMICS
A. K. Oppenheim and A. J. Laderman [1963] 38 p refs
(Grants NsG-10-59; AF-AFOSR-129-63)
(AD-421130)

The wave, besides the possibility of its actual appearance in the course of anomalous operation of the combustion chamber, or its direct exploitation as the actual combustion front in an engine specially designed for this purpose, provides the prime experimental facility for the study of nonsteady gas dynamics of systems characterized by a high rate of energy release. Moreover it offers an insight into the relationship between the chemicokinetic and gas dynamic phenomena that occur in thrust chambers not only during transient processes but also at steady-state operation. Its theoretical aspects provide a stimulus to the development of gas-wave dynamics, the subject dealing with the analysis of wave interaction processes, whose techniques are applicable not only to chemical propulsion systems, but also to gaseous nuclear devices and pulsed plasma accelerators. Author

N64-32989* Case Inst. of Tech., Cleveland, Ohio Digital Systems Lab.
SPECIAL-PURPOSE DIGITAL COMPUTER FOR THRUST OPTIMIZATION CONTROL
David D. Paul Jul. 1964 153 p refs
(Grant NsG-36-60)
(NASA-CR-59077; EDC-1-64-25) OTS: $5.00 ft; $0.75 mf

The objective of this research was the logical design of a special-purpose onboard digital computer that would be used to control the thrust of a space vehicle in a manner to maintain an optimum thrust program. A computer logic is presented that was designed to calculate the optimum thrust control equation

$$V\,\delta D/\delta V - D + VD/C = W$$

that must be satisfied over the vertical sustainer phase of a vehicle's flight. The basic design of the computer evolved around boundary conditions that resulted from a preliminary investigation of the problem, and the prototype computer was implemented. Author

N64-33074 Pratt and Whitney Aircraft, Middletown, Conn.
UNMANNED ELECTRIC PROPULSION MISSION CAPABILITIES OF THE SNAP-50/ IR POWERPLANT
R. J. d'Arcy and G. C. Sinko 2. Oct. 1964 72 p refs
(Contract AT(30-1)-2789)
(PWAC-447) OTS: $1.75

This article pertains to studies of the unmanned electrical propulsion missions of the 300-kWe and 1-mWe SNAP-50/SPUR powerplant, employing a fast spectrum reactor and a Rankin-cycle power-conversion system to produce electrical power. An analysis of the launch booster capabilities is performed, either by launching to earth-escape velocity prior to the startup of the powerplant, or by direct launching into a 700-n.mi. orbit. Specific missions are theoretically investigated. The performance of electrical propulsion vehicles using a SNAP powerplant is compared to the solid-core nuclear rockets and to advanced chemical rockets. G.G.

N64-33120* Rensselaer Polytechnic Inst., Troy, N.Y.
OPTIMUM NUCLEAR ROCKET START-UP TO DEVELOP FULL POWER AT EXACT TIME WITH CONSIDERATION OF NOISE
C. N. Shen and F. G. Haag [1964] 25 p refs Revised Presented at the 6th Intern. Instr. and Meas. Conf., Spec. Sect. on Autom. Control, Stockholm, 17–18 Sep. 1964 Submitted for Publication
(Grant NsG-14-59)
(NASA-CR-59209) OTS: $1.00 fs; $0.50 mf

A nuclear rocket may be required to reach its full power (over six decades of power) within one minute. An optimum switching of the hydrogen flow and the reactivity from the motion of control rod can be achieved to obtain the full power for a minimum time. However, such a bang-bang system may be subject to inaccuracy in time of switching, if the starting power changes or excessive noise is present. A second optimum principle is applied such that the system will be optimum for the remaining time, independent of the past disturbance or starting power. This optimum system with feedback is less susceptible to tandom noise in the reactor and in the instruments than the switching system. Author

N64-33133* General Electric Co., Cincinnati, Ohio Nuclear Materials and Propulsion Operation
INTRODUCTION TO NUCLEAR PROPULSION. LECTURE 21: NUCLEAR ROCKET SYSTEM
Russell E. Motsinger 14–16 May 1963 59 p refs
(Contract NAS8-5215)
(NASA-CR-52964; GEMP-190n, Pt. A) OTS: $3.00 fs; $0.50 mf

Attention is paid to the requirements for interplanetary travel in order to establish a hard-base definition of the minimum capability a rocket vehicle must have to demonstrate any real usefulness and to define the areas attainable by addition of nuclear-energy sources. The treatment of mission analysis is elementary. Weight fractions are discussed for various nuclear-rocket components. Comment is made on optimum mass ratio considering energy expenditure and on propulsive efficiency. A.W.

N64-33144* AVCO Corp., Wilmington, Mass.
EXPERIMENTAL PERFORMANCE OF A HIGH SPECIFIC IMPULSE ARC JET ENGINE
Richard R. John, Stewart Bennett, and John F. Connors N.Y., AIAA [1964] 17 p refs Presented to the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(Contract NAS3-2593)
(AIAA Paper-64-669) AIAA: $0.50 members; $1.00 nonmembers

A liquid cooled arc-jet engine has been operated over the power range from 75 to 200 kW and at specific impulses up to 10000 sec using hydrogen as a propellant. Overall energy conversion defined as the ratio of thrust power to electric input power increases with specific impulse and reaches a value close to 50% at 10000 sec specific impulse. The measured engine thrust is not directly proportional to the product of chamber pressure and throat area, leading to the conclusion that measured engine thrust is not completely aerodynamic in nature. The measured engine thrust can be correlated with current, cathode tip, and chamber pressure on the basis of mechanisms proposed by Maecker to explain the cathode jet characteristic of the high-current carbon arc. Author

N64-33285* Electro-Optical Systems, Inc., Pasadena, Calif.
ION ROCKET SYSTEM RESEARCH AND DEVELOPMENT Monthly Progress Report, 1–31 Aug. 1964
R. C. Speiser 10 Sep. 1964 12 p
(Contract NAS3-5250)
(NASA-CR-59020; EOS-4920-ML-6) OTS: $1.00 fs; $0.50 mf

Results of a 280-hour DE engine test are being analyzed. This test was made with a copper accelerating electrode that, although satisfactory, exhibited a high sputtering ratio; therefore, a search is being made for an optimum electrode material for the 750-hour engine. The permanent magnet engine was fabricated and tested. Several autocathode designs were tested, and a liquid-nitrogen-cooled scanning neutral detector was fabricated. M.P.G.

N64-33377* Consultants and Designers, Inc., Arlington, Va.
USE OF ANNIHILATION FOR SETTING IN MOTION OF PHOTON ROCKETS [ISPOL'ZOVANIYE ANNIGILYATSII DLYA PRIVEDENIYA V DVIZHENIYE FOTONNYKH RAKET]
V. S. Potapkin 12 Oct. 1964 17 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron, (Moscow), no. 4, 1964 p 3–13
(Contract NAS5-3760)
(NASA-TT-F-8969; ST-NP-10218) OTS: $1.00 fs; $0.50 mf

This paper considers the mechanism of the p–P reaction and the possibility of its utilization in rocket powerplants. The problem of focusing the nascent beam with the help of electric and magnetic fields is discussed. Author

N64-33649 Pratt and Whitney Aircraft, East Hartford, Conn.
RESEARCH AND DEVELOPMENT OF TITANIUM ROCKET MOTOR CASE Fourteenth Quarterly Report, 1 Apr.–30 Jun. 1964
H. A. Hauser and R. J. Makowski 31 Jul. 1964 19 p
(Contract DA-19-020-ORD-5230)
(PWA-2364; WAL-TR-766.2/1-16; AD-445826)

Progress made in designing, fabricating, and hydrostatically burst testing a full-scale Ti-13% V-11% Cr-3% Al alloy composite rocket motor case is discussed. The center section of the case will be reinforced with circumferentially wound resin-bonded glass filament. Also discussed is the fabrication and testing for buckling stability of an additional reinforced center section. P.V.E.

N64-33703 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TOWARD THE DESIGN OF A TURBINE WITH VARIABLE PARAMETERS AT THE INLET
I. S. Lyubchenko 21 May 1964 18 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1962, p 129–138
(FTD-MT-63-294; AD-605884)

This is an analytical design description of a turbine with variable parameters at the inlet. Formulas are introduced and developed for a turbine stage whose limited surfaces are coaxial cylinders. During an insignificant increase of axial area by channel length, the above-developed formulas can be successfully applied. G.G.

N64-33712 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Aero-Propulsion Lab.
RADIAL AND BINORMAL THRUSTING TECHNIQUES FOR MANEUVERING SATELLITES IN NEAR EARTH SPACE Technical Documentary Report, Apr. 1963–Jan. 1964
Ambrose F. Manikowski May 1964 43 p refs
(APL-TDR-64-17; AD-603699) OTS: $3.00

The technique of utilizing radial and binormal continuous thrust for changing the position of a vehicle in a near-earth orbit has been investigated. This study has shown that maneuvering satellites employing electric propulsion have an advantage over a comparative chemical or cold-gas system for mission times greater than 20 days. When continuous low thrust is used, the error involved in predicting the position of an evasive satellite is approximately 100 miles, more or less, which depends on the height of the orbit and the thrust level involved. The orbital rendezvous maneuver requires a fine degree of control over the position of the rendezvous ship. It appears that radial and binormal continuous thrust can be employed to provide this control function. Author

N64-33732 Thiokol Chemical Corp., Huntsville, Ala.
NOZZLE AND CASE EVALUATION Quarterly Interim Technical Report, 22 Mar.–21 Jun. 1964
G. F. Mangum 26 Aug. 1964 19 p ref
(Contract DA-01-021-ORD-11919)
(Rept.-30-64; AD-445888)

This report describes the hydrotesting of a 20-in.-diam spiral-wrapped maraged-strip-steel motor case. The report also describes the preparations being conducted for hydrotesting two 12-in.-diam cryogenically formed motor cases and a second-stage Pershing motor case manufactured by the hot-cup, cold-draw process. Also reported are the preparations for static testing a 2-in.-diam titanium boronitride nozzle-throat insert. Author

N64-33781* General Electric Co., Cincinnati, Ohio Flight Propulsion Lab.
INTRODUCTION TO NUCLEAR PROPULSION. LECTURE 14: REACTOR CONTROL APPLICABLE TO NUCLEAR SPACE CRAFT, APRIL 16–18, 1963
G. E. Gorker [1963] 75 p refs
(Contract NAS8-5215)
(NASA-CR-52944; GEMP-190i) OTS: $3.00 fs; $0.75 mf

This report on reactor control as applicable to nuclear spacecraft covers the following topics: "Basic Considerations Which Determine Control System Requirements"; "A Summary of Some Propulsion Control System Requirements"; "Propulsion Control System Operation"; "Control System Measurements"; "Reactor Startup"; "Turbopump Characteristics"; "Reactor Drum Control"; "Typical Control System"; "A Summary of Some Possible Control System Arrangements"; "Engine Control without Using Temperature Measurements"; "Engine Shutdown after Aftercooling the Reactor"; and "Programmer Functions." G.G.

N64-33784* General Electric Co., Cincinnati, Ohio Advanced Technology Services
INTRODUCTION TO NUCLEAR PROPULSION. LECTURE 21: NUCLEAR ROCKET SYSTEM, MAY 14–16, 1963
Russell E. Motsinger [1963] 67 p refs
(Contract NAS8-5215)
(NASA-CR-52948; GEMP-190n, Pt. B) OTS: $3.00 fs; $0.75 mf

This lecture includes the following: (1) systems design considerations—conditions imposed, reactor thermal design and nuclear design requirements, and nonreactor engine components; (2) thermodynamics of fuel elements—formulation for the case of turbulent air in conduit-type passages; (3) generalized thermal design and pressure loss relationships for heat addition to hydrogen in constant area ducts; and (4) nuclear properties—a method for converting nuclear information on critical mass for solid spherical geometry to the more practical cylindrical geometry with voids. D.S.G.

N64-33785* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
EFFECT OF THRUSTOR ARCING ON ION ROCKET SYSTEM DESIGN
John B. Stover N.Y., AIAA [1964] 12 p Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964 Supersedes N64-28081
(AIAA Paper-64-682) AIAA: $0.50 members, $1.00 nonmembers

Arcing between the electrodes of an ion rocket thrustor is investigated for the effect it will have on the overall design of ion rocket systems. The effect of generator, transformer, and inserted impedances on system stability and efficiency, and on operating lifetime of thrustor components is considered. Rate of arcing, preferential arc paths, speed of arc interruption, and response of thrustors to voltage transients are also discussed. The study indicates that arcing is a system hazard and that arcing rates are of prime importance in the design and development of thrustors, thrustor arrays, and system components. Author

N64-33799 Hercules Powder Co., Magna, Utah
AMRAD FOURTH STAGE BE-3-A5 ROCKET MOTOR PROGRAM PLAN
Jul. 1964 56 p
(Contract DA-01-021-AMC-10989(Z))
(HPC-230-12-3-3; AD-445064)

This program plan contains a general description of modifications to be made to the Hercules designed and manufactured BE-3 rocket motor for adaptation to the BE-3-A5 rocket motor. Modifications include areas in design, manufacturing, quality control, and reliability. Author

N64-33809* Aerojet-General Corp., Azusa, Calif. Advanced Power Systems Dept.
A COMPARATIVE MISSION ANALYSIS FOR SOLAR HEATED HYDROGEN PROPULSION SYSTEM. VOLUME I: SYSTEM ANALYSIS Final Report
W. T. Macauley Mar. 1964 292 p refs
(Contract NAS7-230)
(NASA-CR-59332; LO774-01-9) OTS: $6.00 fs; $1.75 mf

This volume presents an analytic tool and computational procedure for evaluating three functionally equivalent solar hydrogen propulsion systems. Specific numerical examples are presented and comparisons are made. The combination of components that produces the lowest system weight is defined. The basic vehicle-SHPS integration problems are discussed, and a model that later becomes the basis for all computations is selected. System weights, in terms usable for mission analysis, are prepared for advanced chemical and nuclear-heated hydrogen systems. Weights of the nuclear electric propulsion system and the solar electric propulsion system are also presented. Author

N64-33853* Pratt and Whitney Aircraft, East Hartford, Conn.
SPACE POWERPLANT STARTUP AND TRANSIENT OPERATION SIMULATION WITH DIRECT-CONDENSING RADIATOR SYSTEM Topical Report, 1 Jun.–1 Dec. 1963
J. R. Hooper and H. R. Kunz 6 May 1964 53 p ref
(Contract NAS3-2335)
(NASA-CR-54179; PWA-2342) OTS: $3.00 fs; $0.50 mf

Experiments were conducted to investigate the feasibility of using a hard-fill method of starting a direct-condensing nuclear Rankine-cycle powerplant in space. In a hard-fill start, only the amount of working fluid required at steady state is injected into the evacuated Rankine-cycle power loop, and no accumulator is provided. The investigations were performed with a powerplant simulator using water and designed to simulate many of the fluid flow and heat-transfer characteristics of such a powerplant. Two problems appeared to arise because of this starting technique: (1) A small error in the amount of fluid injected may cause a significant change in the steady-state operating conditions of the powerplant. (2) The required net-positive-suction head at the power-loop pump inlet probably cannot be maintained during the starting period unless additional control measures are added to the starting procedure. Three means of maintaining the required NPSH were investigated on the simulator. The most practical seemed to be to overfill the system during the starting period from a fill tank and a small pressure-regulating accumulator. The excess fluid is returned to the accumulator as the system approaches steady state. Author

N64-33870* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PERFORMANCE AND STABILITY OF ROCKET ENGINE INJECTORS USING LOX/RP-1 PROPELLANTS
Curtis R. Bailey 4 Sep. 1964 45 p
(NASA-TM-X-53126) OTS: $2.00 fs; $0.50 mf

The performance and stability characteristics were determined for concentric-tube (coaxial), micro-orifice, and impinging jet rocket-engine injectors using lox–RP-1 propellants. The concentric-tube (fuel surrounding oxidizer) injector produced unstable combustion at all mixture ratios greater than 1.5; performance was high. Combustion was stable at all mixture ratios less than 1.5 and performance was lowered. The concentric-tube (oxidizer surrounding fuel) injector was unsatisfactory. Although the micro-orifice injector produced stable combustion and moderately high performance, structural limitations of the micro-orifice material preclude its use. Performance of the impinging jet injector was marginal, and combustion was stable. Author

N64-33917* Aerojet-General Corp., Azusa, Calif.
A COMPARATIVE MISSION ANALYSIS FOR SOLAR HEATED HYDROGEN PROPULSION SYSTEM. VOLUME II: MISSION ANALYSIS Final Report
Mar. 1964 112 p
(Contract NAS7-230)
(NASA-CR-59366; L0774-01-9) OTS: $4.00 fs; $0.75 mf

This volume presents the energy requirements for the space maneuvers and also presents a method of comparing the various propulsion systems of interest. The operations and maneuvers for which data are presented are the following: (1) orbital operations—altitude change, eccentricity change, plane change, position or epoch change, station keeping, and attitude control; (2) interplanetary operations—transfer between plants, capture, co-orbiting, and flyby; and (3) achieving independent heliocentric orbits—circular ecliptic plane, out of ecliptic, and eccentric orbit solar probe. Author

N64-33976 Philco Corp., Blue Bell, Pa. Research Labs.
AN INVESTIGATION AND FEASIBILITY DEMONSTRATION OF NOZZLES FOR RESTARTABLE SOLID ROCKET MOTORS First Quarterly Technical Report
W. H. Armour, J. G. Baetz, H. M. Berkowitz, R. M. Edmiston, R. D. Hackett et al 21 Sep. 1964 146 p refs
(Contract AF 04(611)-9904)
(U-2794; RPL-TDR-64-112; AD-448114)

This program is an analytical study supported by experimental laboratory and rocket motor tests in order to define and solve the problems associated with the restart of solid rocket motor nozzles. These efforts include thermal, structural, and corrosion analysis, materials tests, and rocket motor testing. This report describes the efforts conducted to date on the mechanisms of nozzle heating and cooling, structural response, and various other phenomena, such as corrosion, ablation, etc., occurring during nozzle heating and/or cooling. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see* 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-32788 Naval Observatory, Washington, D.C.
TOTAL SOLAR ECLIPSE OF 30 MAY 1965 Circular No. 102
Julena S. Duncombe and Berenice L. Morrison 1 Sep. 1964 21 p

The paths over the South Pacific and South America of the total and partial phases of the eclipse of 30 May 1965 are mapped and described. The predictions are derived from the basic data given in the "American Ephemeris and Nautical Almanac for 1965." R.L.K.

N64-32836* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF ELECTRON IRRADIATION ON SOME PROPERTIES OF THE ECHO II LAMINATE
Thomas G. James Washington, NASA, Oct. 1964 25 p refs
(NASA-TN-D-2207) OTS: $0.75

Samples of the Echo II laminate, composed of 0.35-mil-thick plastic with 0.18-mil-thick aluminum glued on both sides, were irradiated with electrons with nominal energies of 0.075, 0.15, 0.26, 0.41, 0.66, 0.92, and 1.20 MeV. Incident fluxes up to 2×10^{13} electrons/cm^2/sec were used. The relative percent changes in the modulus of elasticity, ultimate strength, percent elongation at break, burst strength, hardness, and weight per square centimeter were used as measures of damage. The changes in these properties are given as a function of flux, electron energy, and total integrated flux. The results show that the plastic substrate receives the primary damage. The aluminum outer coating was affected only at very high total integrated fluxes and then primarily because of outgassing within the laminate. Author

N64-32887* United Nuclear Corp., White Plains, N.Y. Development Div.
THE USE OF GAMMA PROBING TO DETERMINE THE SHIELDING EFFECTIVENESS OF SPACE VEHICLES
A. D. Krumbein and F. Johnson 18 Feb. 1964 57 p refs
(Contract NAS8-5252; UNC Proj. 2193)
(NASA-CR-58783; UNC-5075) OTS: $3.00 fs; $0.50 mf

The feasibility and practicality of using a gamma-ray probe technique to determine the shielding effectiveness of various material configurations against proton radiation have been demonstrated. The experimental technique and calculational procedure involved are explained, and results are given for simple arrays and actual pieces of space equipment. Author

N64-32895* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS VII: ABSORPTION AND PHOTOIONIZATION CROSS SECTIONS OF ATMOSPHERIC GASES AT INTENSE SOLAR EMISSION LINES: N_2, O_2, CO_2, CO, A, AND He
J. A. R. Samson, R. B. Cairns, and F. L. Kelley Sep. 1964 36 p refs Submitted for Publication
(Contract NASw-840)
(NASA-CR-59021; GCA-TR-64-13-N) OTS: $2.00 fs; $0.50 mf

Photoionization and total absorption cross sections have been measured for O_2, N_2, CO_2, CO, A, and He at wavelengths in the range 1040 to 300Å, which correspond to intense solar emission lines. These lines were produced in the laboratory using a high-voltage condensed spark discharge and a dc glow discharge. Many of the lines were completely resolved by the vacuum monochromator. The wavelength bandpass was not, therefore, limited to that of the lines generated within the light sources. The widths of these lines ranged from 0.04 to 0.1Å. A short discussion is given of the experimental techniques employed and of the data obtained. Author

N64-32977 San Andres U., La Paz (Bolivia) Laboratorio de Fisica Cosmica
EXTENSIVE AIR SHOWERS AT 5200 METRES ABOVE SEA LEVEL AND SEARCH FOR HIGH ENERGY PRIMARY GAMMA RAYS
G. Clark (MIT), I. Escobar, K. Murakami, and K. Suga (Tokyo U.) *In* Scripta Varia (Vatican City), v. 25, 1963 p 29–60 refs
(Contract AF 49(638)-922)
(AD-442210)

The report is presented in two parts. Part I describes the chief characteristics of EAS observed at 5200 m above sea level. Part II outlines mainly the approach for the search for high energy primary gamma rays. The results indicate that a group of showers exist having an extraordinarily small proportion of muons. The ratio of the frequency of this group of showers to that of ordinary showers is $\sim 3 \times 10^{-4}$ for energies above 10^{15} eV. It is suggested that this group of showers may have as their parent high energy primary gamma rays although the possibility of this group of showers having been produced by an extreme fluctuation of a few neutral pions cannot be ruled out. Further, there is some indication of a possible excess of the muonless showers coming from the plane of galaxy though this result has not been established with high enough statistical precision. Author

N64-33036* Argonne National Lab., Ill.
RATIO OF ELECTRONS TO POSITRONS IN THE PRIMARY COSMIC RADIATION
James A. De Shong, Jr., Roger H. Hildebrand, and Peter Meyer Repr. from Phys. Rev. Letters, v. 12, no. 1, 6 Jan. 1964 4 p refs
(Grant NsG-144)

The positron–electron ratio was measured as a function of energy. The equipment consisted of a permanent magnet, a spark chamber telescope for the determination of the particle trajectory before and after passing through the magnetic field, and a tantalum-plate spark chamber for particle identification. The spark chambers were triggered by a triple coincidence counter telescope that included a Cerenkov counter. The counter excluded upward-moving particles and protons with energy below about 600 MeV. The spark-chamber array was photographed by two 16-mm cameras. From the data gathered in two balloon flights the following conclusions were drawn: (1) The primary electron component contains an excess of negative electrons that cannot be attributed to the p-p collision source. (2) The fraction $e^+/(e^+ + e^-)$ appears to decrease with increasing energy between 100 MeV and 1000 MeV. Reasons are given for assuming the observed primary electrons to be of galactic and not of solar origin. R.L.K.

N64-33040* California U., Los Angeles Inst. of Geophysics and Planetary Physics
CHARACTERISTICS OF THE REGION OF INTERACTION BETWEEN THE INTERPLANETARY PLASMA AND THE GEOMAGNETIC FIELD: PIONEER 5
P. J. Coleman, Jr. [1963] 90 p refs
(Grant NsG-249)
(NASA-CR-58961) OTS: $3.00 fs; $0.75 mf

Measurements of the magnetic fields in the distant geomagnetic cavity and in the region of interaction between the solar wind and the magnetosphere are described. These measurements were obtained with instruments aboard the interplanetary probe Pioneer 5, in the region between 5.2 and 15.4 Re, and between 1500 and 1700 local time. The observations obtained between 5.2 and 15.4 Re are found to be consistent with a geomagnetic boundary region that exhibits an enhanced field just inside the geomagnetic cavity, and beyond the cavity, a region of disordered fields in which both the mean field and the amplitude of the field variations decrease with increasing geocentric distance. Author

N64-33059 Joint Publications Research Service, Washington, D.C.
CONFERENCE ON COSMIC RAYS IN JAIPUR
N. A. Dobrotin 27 Oct. 1964 8 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 7, Jul. 1964 p 88–92
(JPRS-27105; TT-64-51361) OTS: $1.00

The main topics discussed at this conference pertained to the studies on the neutrino, an electrically neutral particle that is found each time a proton–neutron conversion takes place or during the disintegration of mesons, the studies of high-energy nuclear reactions and the mechanism of the generation of secondary particles, the problem of large atmospheric showers, and the intensity variations of cosmic rays. The future formation of a new branch of astronomy—neutrino astronomy—was predicted. G.G.

N64-33123* California U., La Jolla
RELAY I TRAPPED RADIATION MEASUREMENTS
C. E. Mc Ilwain, R. W. Fillius, J. Valerio, and A. Dave Mar. 1964 56 p refs
(Contracts NAS5-1683; NASr-116)
(NASA-CR-59023) OTS: $3.00 fs; $0.50 mf

Instruments aboard the Relay I satellite have measured the intensities of geomagnetically trapped electrons with energies greater than 0.45 MeV and of protons in four energy ranges between one and 60 MeV over the region between 1.2 and 2.3 earth radii during the year 1963. The equatorial intensity of electrons ($E > 0.45$ MeV) was found to decrease monotonically from a maximum intensity of about 0.7×10^8 at 1.3 earth radii down to 10^5 $sec^{-1}cm^{-2}sr^{-1}$ at 2.3 earth radii. The principal maximum in the proton intensities was found to occur on consistently higher lines of force and with increasing intensities toward lower energies such that a maximum intensity of about 3×10^6 protons ($E > 1.1$ MeV) $sec^{-1}cm^{-2}sr^{-1}$

occurs at about 2.3 earth radii compared with the maximum of 1.95×10^3 protons (E = 40 to 110 MeV) $sec^{-1}cm^{-2}sr^{-1}$ at 1.5 earth radii. Author

N64-33152* State U. of Iowa, Iowa City
RECENT OBSERVATIONS OF ELECTRON INTENSITIES IN THE EARTH'S OUTER MAGNETOSPHERE AND BEYOND
L. A. Frank, J. W. Freeman, Jr., and J. A. Van Allen Amsterdam, North-Holland, 1964 21 p refs Repr. from Space Res. IV, Proc. of the Fourth Intern. Space Sci. Symp., Warsaw, 3–12 Jun. 1963, v. 4, no. 4 p 588–605
(Grant NsG-233-62)

Results of the electron intensity measurements reported are concerned with the following: (1) the nature of the interface between the region dominated by the geomagnetic field and the region of the interplanetary medium; (2) evidence for a "piston" of quasi-thermalized solar plasma, consisting predominantly of 1 to 10 keV electrons, on the sunward side of the magnetospheric boundary and having a radial thickness of some 10 000 km; (3) a comprehensive mapping of the omnidirectional intensity of electrons of energy $\geq$40 keV, showing that, near the geomagnetic equatorial plane, the magnetospheric boundary occurs typically at about 10 earth radii at the subsolar point and has an approximately circular form to a sun–earth-probe angle of about 70°, then "flares out" to an ogival shape with a radial distance of some 16 earth radii on the dawn meridian; and (4) the discovery of a relative "void" of electrons of energy $\geq$40 keV on the night side of the earth in a region bounded on its earthward side by the "classical" region of trapped, outer zone electrons at 7 earth radii and on its outward side by the ogival skirt of much higher intensities. Author

N64-33183* Avco-Everett Research Lab., Everett, Mass.
THE TAIL OF THE MAGNETOSPHERE
W. I. Axford, H. E. Petschek, and G. L. Siscoe Aug. 1964 14 p refs
(Contract NASw-837)
(NASA-CR-58845; Avco-Everett Res. Rept.-190) OTS: $1.00 fs; $0.50 mf

The Chapman and Ferraro model of the magnetosphere is entirely dissipationless, and as a consequence contains no tangential stress at the magnetosphere boundary. It has been suggested that either viscous interaction or reconnection of field lines can give rise to tangential stresses that produce internal convection within the magnetosphere. Recent measurements related to the magnetosphere tail lend further support to the suggestion that tangential stresses play a significant role. In particular the observations of a strong magnetic field in the tail aligned radially from the earth, the departures of the magnetic field from the Finch and Leaton field in the neighborhood of 5 to 12 earth radii in the antisolar direction, the existence of a low-energy particle flux in the tail, the latitude of the boundary of trapped particles as well as its day–night asymmetry, and the low-energy cosmic ray cutoff are all consistent with this picture. Author

N64-33257 Institut Royal Meteorologique de Belgique, Brussels
SOLAR RADIATION AT UCCLE–1963 [RAYONNEMENT SOLAIRE A UCCLE. ANNEE 1963]
1964 66 p *Its* Publ. Ser. A, No. 49 In FRENCH

Tables of daily solar radiation values obtained at Uccle, Belgium, are presented for the year 1963. The tables include the following: (1) duration of insolation (in minutes) obtained by Campbell–Stokes heliography; (2) duration of insolation (in minutes) obtained by actinometric heliography; (3) direct solar radiation (in kilocalories/m^2); (4) total solar radiation; and (5) diffuse solar radiation. M.P.G.

N64-33274 High Altitude Observatory, Boulder, Colo.
A STUDY OF LINE SPECTRA FORMED IN A DIFFERENTIALLY MOVING ATMOSPHERE Scientific Report No. 3
John Lewis Kulander (Ph.D. Thesis;—Colorado U.) Sep. 1964 206 p refs
(Contract AF 19(604)-6664)
(AFCRL-64-735; AD-606840)

Line profiles exhibiting complex quasi-oscillatory displacements and asymmetries have been observed on solar and stellar spectra. In this study observational and theoretical aspects are combined to determine the time and depth variation of gross velocity fields in the regions of the outer solar atmosphere where the cores of the H-α and K lines of Ca II are formed. Methods of expressing line profiles are calculated for various velocity and temperature models. Author

N64-33383* Consultants and Designers, Inc., Arlington, Va.
COSMIC RAYS AND GEOLOGY [KOSMICHESKIYE LUCHI I GEOLOGIYA]
Ya. L. Blokh and V. M. Bondarenko 20 Oct. 1964 9 p Transl. into ENGLISH from Priroda (Moscow), no. 9, Sep. 1964 p 85–89
(Contract NAS5-3760)
(NASA-TT-F-8975; ST-ES-CR-10224) OTS: $1.00 fs; $0.50 mf

Measurements of the flux of cosmic rays in mines and tunnels were used to determine the density of the earth between the place of measurement and the surface of the earth. Various methods for obtaining the measurements and interpreting the results are outlined. P.V.E.

N64-33389* Consultants and Designers, Inc., Arlington, Va.
INVESTIGATION OF MAGNETIC FIELDS ON THE SUN [ISSLEDOVANIYE MAGNITNYKH POLEY NA SOLNTSE] Review Paper
A. B. Severnyy 30 Oct. 1964 10 p
(Contract NAS5-3760)
(NASA-TT-F-8982; ST-SP-10230) OTS: $1.00 fs; $0.50 mf

The photoelectric method of measuring moderately intense magnetic fields on the sun is described. High-resolution analysis of the magnetic-field vectors associated with sunspots and solar flares was made possible by using the tower telescope at the Crimean Observatory, which gave a solar spectrum of 30-A dispersion. Very high-field gradients were discovered on the solar surface. Strong field-vector turns were found at depths less than 100 km in sunspots. Spasmodic field variations were shown to be connected with flares. The structure of sunspot fields is described at length, and certain basic assumptions of solar plasma properties are stated to be in need of revision. D.E.W.

N64-33455* High Altitude Observatory, Boulder, Colo.
THE EQUILIBRIUM OF BARIUM IN THE SOLAR ATMOSPHERE
Einar Tandberg-Hanssen Repr. from Astrophys. J., Suppl. Ser., v. 9, no. 88, Aug. 1964 p 107–140 refs
(Grant NsG-92)

The equilibrium conditions of Ba II in the chromosphere and in quiescent prominences are discussed. The chromospheric resonance lines are not formed under optically thin conditions. The faint lines indicate an emission scale height of about 225 km. The chromospheric emission can be accounted for in terms of local thermodynamic equilibrium (LTE

at a temperature of 6000° K. Alternatively, the temperature may be as high as 8000° K if departures (b ~100) from LTE are allowed. Several lines of Ba II have been observed in dense quiescent prominences. The emission is discussed in some detail and indicates that the lines (as expected) are formed under conditions far removed from LTE, since for all temperatures $T > 5000°$ K the LTE assumption and the observed electron density show that all barium would exist as Ba III. The line profiles are gaussian, indicating a broadening velocity of about 5 km/sec. Author

N64-33550 Pennsylvania State U., University Park Ionosphere Research Lab.
PARTICLE TRAJECTORIES IN A MODEL CURRENT SHEET, BASED ON THE OPEN MODEL OF THE MAGNETOSPHERE, WITH APPLICATIONS TO AURORAL PARTICLES Scientific Report No. 222
T. W. Speiser 10 Oct. 1964 112 p refs
(Contract AF 19(628)-4014; NSF GP-2914)
(AFCRL-64-726; AD-607268)

Adiabatic theory, which is good throughout most of the magnetosphere, breaks down near a neutral point in the current sheet, and particle trajectories must, therefore, be computed. The computation is done using an IBM-7074 computer. Only proton trajectories are studied extensively, and the results yield accelerated output protons with high intensity in a thin sheet, with perhaps some thin beam structure within the sheet. Such a production of thin sheets or beams of accelerated particles is necessary for an auroral theory. The energy of the output protons is 900 times the energy of the particles in the incident stream, but this energy is still about an order of magnitude smaller than that observed for auroral protons. Preliminary results with a few electron trajectories indicate that the model should yield electron energies of about the right order of magnitude for auroral electrons. Author

N64-33562* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STUDIES OF SOLAR PROTONS WITH EXPLORERS XII AND XIV
D. A. Bryant, T. L. Cline, U. D. Desai, and F. B. Mc Donald Jul. 1964 51 p refs
(NASA-TM-X-55087; X-611-64-217) OTS: $3.00 fs; $0.50 mf

The rate of propagation of solar protons in some primary events is linearly dependent on particle velocity, and this dependence makes it possible to separate the source characteristics from the propagation effects. In each event that shows this velocity dependence the propagation curves of all observed energies agree and reach maximum intensity at a time much greater than the rectilinear travel time. These results lead immediately to the conclusions that propagation involves an important degree of scattering and that the degree of scattering is independent of energy over the observed range of 1.4 to 500 MeV. Author

N64-33592* Consultants and Designers, Inc., Arlington, Va.
RADIOASTRONOMICAL OBSERVATIONS FOR DETERMINING THE POSITION OF THE REGION OF RAPID VARIATION OF THE CHARACTERISTICS OF SOLAR ATMOSPHERE [OPREDELENIYE POLOZHENIYA OBLASTI BYSTROGO IZMENENIYA KHARAKTERISTIK SOLNECHNOY ATMOSFERY PO REZUL'TATAM RADIOASTRONOMICHESKIKH NABLYUDENIY]
A. P. Molchanov 21 Oct. 1964 6 p refs Transl. into ENGLISH from Astronomiya, Dokl. Akad. Nauk SSSR, v.158, no. 2 p 302–304
(Contract NAS5-3760)
(NASA-TT-F-8976; ST-RA-SP-10225) OTS: $1.00 fs; $0.50 mf

This is a study of the radioastronomical determination of the sun's radioradius by time differentiations of lunar and solar disk contacts measured optically or by radio methods. It was observed that near some of the contacts the variation of the solar disk takes place more rapidly making a more precise determination of the photosphere radius possible, than by the utilization of other contacts. It is possible to make several sufficiently accurate determinations of the sun's radioradius in several wavelengths simultaneously during a solar eclipse. G.G.

N64-33618* Geophysics Corp. of America, Bedford, Mass.
ERROR ANALYSIS OF INVERSION TECHNIQUES Fourth Quarterly Report, 11 Jan.–10 Apr. 1964
Jean I. F. King [1964] 21 p refs
(Contract NAS5-3352)
(NASA-CR-60022) OTS: $1.00 fs; $0.50 mf

The problem of the formulation of a optimum inversion technique for inferring vertical temperature structure from remote radiometric observations is discussed in general. A new inversion method, the variable slab technique, is proposed for solving the problem where an algorithm is sought for the inference of atmospheric vertical thermal structure from remotely sensed radiometric observations. The application of the technique to two illustrative examples is demonstrated. P.V.E.

N64-33627* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC EFFECTS OF THE QUIET TIME PROTON BELT
R. A. Hoffman and P. A. Bracken Jun. 1964 52 p refs
(NASA-TM-X-55078; X-611-64-186) OTS: $3.00 fs; $0.50 mf

An analysis of the magnetic effects of the quiet-time proton belt has been performed with data obtained from a proton detector aboard Explorer XII. From the measured energy spectra, intensities, and pitch angle distributions of the protons with energies above 100 keV, the current density on a magnetic meridian plane was calculated using the theory of Akasofu and Chapman, modified to eliminate several simplifying assumptions. The algebraic sum of all the currents was 0.59 million amperes, and the magnetic moment of the current loop was $0.029M_E$. From the electric current distribution the magnetic perturbations on the meridian plane were obtained. At the magnetic equator on the earth's surface the proton belt produced a 9γ decrease in the field in comparison with the 38γ decrease reported by Akasofu, Cain, and Chapman based on some preliminary data from the same detector. The maximum perturbation appeared at L = 3.6 on the magnetic equator, where the field attained a value of −23γ. Author

N64-33628* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DISTRIBUTION IN HELIOGRAPHIC LONGITUDE OF FLARES WHICH PRODUCE ENERGETIC SOLAR PARTICLES
Donald E. Guss Jul. 1964 7 p refs
(NASA-TM-X-55086; X-611-64-218) OTS: $1.00 fs; $0.50 mf

This is a study of solar flares of a similar longitudinal persistence resulting in the production of energetic particles. The existence of long-lived active centers, which periodically display themselves on the surface of the active region beneath the surface, is indicated. A single, well-defined longitude region of a 10° band in a certain period of the solar rotation indicated that this side rotated at a constant rate, as opposed to the variable rotation of the photosphere. The shorter lived regions showed a wider spread in longitude, indicating a drift of the producing centers. G.G.

N64-33686* Stanford U., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semi-Annual Report No. 3, 1 Jan.–30 Jun. 1964
V. R. Eshleman Jul. 1964 9 p refs
(Grant NsG-377)
(NASA-CR-59325) OTS: $1.00 fs; $0.50 mf

This research program on radio and radar studies of the lunar and planetary ionospheres, atmospheres, and surfaces, and radar studies of the sun and interplanetary medium contains the following articles: "Planetary Research"—correlation characteristics of the radio-noise storm from Jupiter and from the Sun; "Propagation Characteristics through the Solar Corona"—a doppler shift observation in a radio wave sent from the earth to a solar probe; "Magnetohydrodynamic waves in Interplanetary Space"—the use of radar astronomy techniques for MHD waves in the interplanetary medium; "Solar Radar Program"—a conclusion that no solar echoes were present in the 1963 solar data; and "Cislunar Gas Studies"—automatic data-processing techniques development to edit and to store lunar data, a study of several methods to measure cislunar gas density, and development of a method to measure the total daily electron content in the ionosphere as a function of time and rate of change in electron content over the entire earth–moon path. G.G.

N64-33704 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EXPLORATIONS OF OUTER SPACE AND UPPER LAYERS OF THE ATMOSPHERE
A. A. Blagonravov 17 Apr. 1964 15 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), v. 33, no. 9, 1963 p 9–16
(FTD-MT-63-345; AD-605586)

Recent U.S.S.R. space explorations are reviewed, including the manned Vostok flights, the Mars I interplanetary space probe, the series of Cosmos satellites that investigated the upper layers of the atmosphere and near space, geophysical and meteorological rockets, and ground-based radiolocation of Mercury, Venus, and Mars. M.P.G.

N64-33705* Lockheed Missiles and Space Co., Sunnyvale, Calif.
HEAT FLUX STUDY
T. S. Newby, R. G. Eurich, and D. Ow 15 Jul. 1964 352 p Prepared for JPL
(Contracts NAS7-100; JPL-950674)
(NASA-CR-59281; M-16-64-1) OTS: $7.00 fs; $1.75 mf

The parametric study shows the effect of altitude, orbit–solar incidence angle, orbit position surface orientation, surface dimensions, and surface radiation properties on the solar, albedo, and planetary heat fluxes incident on, and absorbed by, two satellite radiator-surface configurations in the vicinity of Venus and Mars. The generalized heat flux program has the capability of computing the solar, albedo, and planetary fluxes incident on and absorbed by up to 20 surfaces of a sun-oriented or planet-oriented satellite in circular or elliptical orbit about any planet. The surfaces may consist of rectangles, trapezoids, and/or disks in any combination or orientation. Output from the program is heat flux vs time on printed tape and punched cards. Author

N64-33729 Sacramento Peak Observatory, Sunspot, N. Mex.
X-RAY EMISSION OF FLARES ORIGINATING BEHIND THE SOLAR DISK Solar Research Note No. 47
Y. I. Vinogradov and N. N. Eryushev [1963] 6 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (USSR), v. 29, 1963 p 141–145
(AD-424481)

In some cases sudden ionospheric disturbances are observed at times when there are no flares on the solar disk. During 1959 there were 18 such cases. It is shown that the detected SID's were due to flares originating behind the limb of the solar disk. Recordings of the integrated intensity of atmospherics in the long-wave range were used as indicators of the SID. Author

N64-33810* Alaska U., College
AN INVESTIGATION OF SELECTED TYPES OF RADIO-WAVE ABSORPTION EVENTS IN THE AURORAL ZONE
F. T. Berkey and R. Parthasarathy May 1964 83 p refs
(Contract NAS5-3595; Grant NSF GP-947)
(NASA-CR-59342; UAG-R151) OTS: $3.00 fs; $0.75 mf

As a result of a study of cosmic radiowave absorption records for the period 1961–1963 from a network of Alaskan riometer stations located near the auroral zone maximum, three characteristic absorption events have been identified: (1) Type-F events, characterized by a sudden increase in absorption (<5 min); (2) Type-S events, characterized by a slow increase and slow recovery of absorption (≤30 min), and which occur during quiet conditions, and; (3) Type-P events, characterized by a more or less regular periodicity of absorption. The temporal and spatial aspects of these events were investigated and found to vary with geomagnetic latitude. Author

N64-33828 Lockheed-California Co., Burbank Solar Physics Lab.
RESEARCH ON SOLAR MAGNETIC FIELDS Semiannual Technical Summary Report No. 3, 1 Feb.–31 Jul. 1964
D. S. Webber 10 Aug. 1964 5 p
(ARPA Order 215)
(AD-444351)

An analysis of the solar magnetic field data obtained at Mount Wilson from August 1959 through December 1962 was made by the correlation of the solar magnetic field configurations and their changes with the chromospheric phenomena. The development of unipolar regions from unipolarity remnants of several old bipolar regions was observed, and their tendency to drift to higher latitudes was confirmed. Synoptic charts were constructed from the isogauss maps and were used in the identification of large-scale magnetic field patterns. In a power spectrum analysis applied to the listed locations of calcium plage regions, a definite tendency for the regions to occur at symmetrical spacings in longitude relative to one another was found. G.G.

N64-33859 American Meteorological Society, Boston, Mass.
THE BIREFRINGENT FILTER AND ITS APPLICATIONS IN SOLAR PHYSICS [LE FILTRE MONOCHROMATIQUE POLARISANT ET SES APPLICATIONS EN PHYSIQUE SOLAIRE]

Bernard Lyot Bedford, Mass., AFCRL, Dec. 1963 82 p refs Transl. into ENGLISH from Ann. Astrophys. (Paris), v. 7(1/2), 1944 p 31–79
(Contract AF 19(604)-6113)
(AD-445281)

This is a description of a new birefringent monochromatic filter that utilizes a variable wavelength filter, as well as a second filter for the isolation of six fixed radiations belonging to the chromosphere and to the corona. Variations of the transmitted wavelength as a function of temperature, and two methods for varying this wavelength were studied. A series of photos and films showed very rapid movements of the solar prominences while the corona remained entirely immobile in monochromatic light. Arches or clouds brighten by turns like the rays of a polar aurora, but no displacement can be seen. G.G.

N64-33890* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPECIFIC SOLAR FLARE EVENTS AND ASSOCIATED RADIATION DOSES
T. Foelsche Repr. from Symp. on Space Radiation Effects, Spec. Tech. Publ. no. 363, 1963 13 p refs
(NASA-RP-355)

Spectral variations of specific solar flare particle events are considered, and an estimate of the doses in free space for different shielding thicknesses for the events of the highly active period from May 1959 to November 1960 is given. The high-energy part of the spectra (E greater than 20 MeV), because of the minimum amounts of shielding present and the relatively low intensities behind such shielding, is primarily important for its effects on man. With respect to effects on material and sensitive electronic devices, attention is given to low-energy protons in the MeV range, which have been observed since late 1960 to be present in appreciably higher intensity during proton events associated with large magnetic storms. Author

N64-34019* National Aeronautics and Space Administration, Washington, D.C.
CORPUSCULAR SOLAR RADIATION ON THE DESCENDING CURVE OF THE SOLAR ACTIVITY CYCLE [KORPUSKULYARNOYE IZLUCHENIYE SOLNTSA NA NISKHODYASHCHEY VETVI TSIKLA SOLNECHNOY AKTIVNOSTI]
A. S. Dvoryashin and L. S. Levitskiy Nov. 1964 27 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (USSR), v. 27, 1962 p 167–177
(NASA-TT-F-225) OTS: $0.75

A short review of empirical and theoretical investigations is given that is concerned with the relation between geomagnetic disturbances and active solar regions on the descending curve of the solar activity cycle. For the period from February 1940 to May 1944 individual comparisons are made between geomagnetic disturbances and active regions of the sun whose indicators are flocculi. All of the flocculi observed during this time (the active region) are divided into two groups—flocculi of group I, which at the moment of central meridian passage crossed the visible center of the disk or were adjacent to it, and flocculi of group II, for which the heliocentric angle ψ (distance between the parallel of the visible center of the disk and the part of the flocculi closest to it) is equal to or exceeds 6°. Author

N64-34020* National Aeronautics and Space Administration, Washington, D.C.
PROTON FLARES FROM 1957 TO 1961 AND THE GEOMETRY OF INTERPLANETARY MAGNETIC FIELD. I [PROTONNYYE VSPYSHKI 1957–1961 GG. I GEOMETRIYA MEZHPLANETNOGO MAGNITNOGO POLYA.]
A. S. Dvoryashin Nov. 1964 17 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 28, 1962 p 293–304
(NASA-TT-F-226) OTS: $0.50

Chromospheric flares, which are accompanied by the generation of high energy protons (approximately 10 to 100 MeV) and the ejection of plasma with a magnetic field (proton flares), have been identified with the use of solar, ionospheric, and geomagnetic data for 1957–1961. From an analysis of the absorption rate as a function of time at high geomagnetic latitudes, a conclusion is reached concerning the geometry of the interplanetary magnetic field and the variation of this field with time. The succession of phenomena that develop in the neighborhood of the earth as a result of proton flares, originating in the same active region (March–April 1960, November 1960), is studied in detail. Author

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-32823* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MOON-TO-EARTH TRAJECTORIES
Sarterios S. Dallas Repr. from Progr. Aston. Aeron., v. 14, 1964 p 391–438 refs Presented at AIAA Astrodyn. Conf., New Haven, 19–21 Aug. 1963
(Contract NAS7-100)
(JPL-TR-32-412(Rev. 1); AIAA Paper-63-402)

The design and characteristics of trajectories that initiate on the surface of the moon and terminate at a specific landing site on the surface of the earth are presented, along with computing techniques for such trajectories. Results from an analytic trajectory-computing program are used for the qualitative discussions, and results from a precision integrating program are used for the quantitative discussions. Author

N64-32824* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
GUIDANCE OF UNMANNED LUNAR AND INTERPLANETARY SPACECRAFT
Carl G. Pfeiffer Repr. from Progr. Astron. Aeron., v. 14, 1964 p 259–281 refs Presented at the AIAA Astrodyn. Conf., New Haven, 19–21 Aug. 1963
(Contract NAS7-100)
(JPL-TR-32-472; AIAA Paper-63-399)

This paper describes mathematical techniques that have been developed for accomplishing earth-based guidance of unmanned lunar and interplanetary spacecraft. The orbit-determination and guidance-correction aspects of the problem are developed from linear perturbation techniques, well known in exterior ballistics problems. An expression for the effect of neglected second-order terms is developed. The treatment of correlated noise on the orbit determination data is discussed. Policies for determining when to perform impulsive guidance corrections to the orbit are described, and a technique for optimal guidance of powered flight trajectories is outlined. Author

N64-32851 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

A PROGRAM FOR COMPUTING SATELLITE GROUND TRACES AND VEHICLE-SUN ORIENTATION

W. M. Pauson and T. Coffin May 1964 45 p

(R64SD42; AD-444925)

This report describes a computer program that may be used to rapidly find the ground trace of a satellite with respect to a rotating earth, as well as the orientation of the sun with respect to the satellite, as functions of time. The program is designed to accept input data as provided in SPADATS bulletins. Motion is considered to take place in a two-body force field, but the capability of applying approximate corrections for the perturbations due to the earth's oblateness and atmospheric drag exists in the program. The ground trace program has been written for the IBM 1620 computer, and a FORTRAN listing is included. Author

N64-32991* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

PUBLICATIONS OF THE JET PROPULSION LABORATORY, JULY 1963–JUNE 1964

Joe Dyer, Jr. 31 Aug. 1964 62 p refs

(Contract NAS7-100)

(NASA-CR-58761; JPL-Bibl.-39-5) OTS: $3.00 fs; $0.50 mf

This bibliography is a compilation of offical reports. It includes abstracts of technical reports and memoranda, lists of summary publications, and abstracts of literature searches and translations. R.L.K.

N64-33000* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

DETERMINATION OF SOME PHYSICAL PROPERTIES OF THE ATMOSPHERE OF MARS FROM CHANGES IN THE DOPPLER SIGNAL OF A SPACECRAFT ON AN EARTH OCCULTATION TRAJECTORY

Arvydas Kliore, Dan L. Cain, and T. W. Hamilton 15 Oct. 1964 42 p refs

(Contract NAS7-100)

(NASA-CR-59161; JPL-TR-32-674) OTS: $2.00 fs; $0.50 mf

The expressions describing the effects of refraction in the atmosphere are derived and used to compute expected doppler changes for several isothermal model atmospheres of Mars, using typical 1964 and 1966–1967 Earth-occulting Mars flyby trajectories. Based on these computed results, and on the expected data accuracy, it is estimated that the scale height and surface density of the atmosphere of Mars can be determined with an accuracy of better than 10% by means of the experiment. In addition, several limitations of the experiment are described, and their effects on the results are discussed. Author

N64-33020* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE INFLUENCE OF THE CHEMICAL COMPOSITION ON THE STRUCTURE AND METAL INDEX OF STELLAR ATMOSPHERES

David Fischel Repr. from Astrophys. J., v. 140, no. 1, 1 Jul. 1964 p 221–234 refs

(NASA-RP-331)

An attempt to correlate Stromgren's photometric metal index with observations on the chemical compositions in stellar atmospheres is described. The metal index m_1 is defined by $m_1 = (v-b) - (b-y) + \text{constant}$, where v, b, and y are the magnitude of a star as observed through narrow-band filters centered at 4100 Å, 4700 Å, and 5500 Å, respectively. Thus, m_1 is in the form of a color index that measures the amount of energy absorbed in the v region relative to that absorbed in the comparatively line-free y region. Values of m_1 are found for a series of model atmospheres with various hydrogen-to-metal ratios, for main sequence stars in the spectral range FO to KO. Attempts to correlate m_1 with the heavy-element abundances in these stars are discussed. IAA

N64-33049* Smithsonian Astrophysical Observatory, Cambridge, Mass.

DIFFERENTIAL ORBIT IMPROVEMENT (DOI-3)

E. M. Gaposchkin 3 Aug. 1964 75 p refs

(Grant NsG-87-60)

(NASA-CR-59138; SAO Special Rept.-161) OTS: $3.00 fs; $0.75 mf

This is a complete mathematical formulation with flow charts and operating descriptions for use of this program in differential orbit improvement. It describes the reduction of observations to a uniform system with the help of direction cosines in right ascension and declination, in azimuth and altitude, and in range; the different time systems; the solution of the idealized two-body problem and its perturbations; computation of satellite position by equation; orbit improvement with differential corrections and the development of equations of condition; station positions in the geodetic system and in the coordinate satellite system; and the least-square solution in terms of the residuals *du* and *dw*. Included also are "Rejection Criteria", "Input", and "Output." G.G.

N64-33064* Consultants and Designers, Inc., Arlington, Va.

MOON DROPS (A NEW VIEWPOINT ON THE ORIGIN OF TEKTITES) [SLEZY LUNY]

13 Jul. 1964 5 p Transl. into ENGLISH from Nedelya (Moscow), 21–27 Jun. 1964

(Contract NAS5-2078)

(NASA-TT-F-8944; ST-PR-10168) OTS: $1.00 fs; $0.50 mf

This article covers the hypothesis that tektites are minerals of lunar origin. Several tektite sites are described, with emphasis given to the australites. It was found that the australites came across the melting point twice, and their age was established by uranium tracks as being about 700 000 years. Their contents of 10.2% nickel along with two combinations of schreibersite and troilite, only found in extraterrestrial bodies, do not exclude the fact that the origin of tektites might be located much further in space than the moon. G.G.

N64-33134* Space Technology Labs., Inc., Redondo Beach, Calif.

SPACE SYSTEMS ANALYSIS STUDY Summary Report, Jan. 1961–Mar. 1962

E. H. Tompkins et al 12 Mar. 1962 170 p refs

(Contract JPL-950045)

(NASA-CR-50435; Rept.-8976-6006-RU-000) OTS: $5.00 fs; $1.00 mf

An analytic lunar return program is described. The three-dimensional trajectory model used in the program is "analytic" in the sense that it consists of two closed-form (conic) trajectories that are joined at the moon's sphere of influence. The sensitivity of moon-to-earth trajectories to launch errors (influence coefficient analysis) and midcourse corrections is discussed. Two moon-to-earth-mission analysis studies were performed and are discussed. The studies covered, in addition to free-flight trajectory analysis, are these: (1) a parametric study of powered flight from the lunar surface; (2) an analysis of launch guidance errors; and (3) Monte Carlo simulations of tracking and midcourse guidance. Two basic categories of circumlunar trajectories considered are free return (or true circumlunar) and nonfree return, in which a velocity increment ΔV is required

in the vicinity of the moon to modify the nominal trajectory and make it return to earth. The Tracking Accuracy Prediction Program (TAPP, Mod I) is discussed. The program was designed as an analytical tool for predicting the results of real-time tracking and guidance of spacecraft. The TAPP I determines the covariance matrix of estimates of orbital parameters for various types of observational data, data rates, tracking intervals, and observational noise models. P.V.E.

N64-33162* Bellcomm, Inc., Washington, D.C.
LUNAR PHOTOGRAPHIC ORBITER: LIGHTING AND VIEWING CONDITIONS
C. J. Byrne 11 Oct. 1963 13 p refs
(Contract NASw-417)
(NASA-CR-59192) OTS: $1.00 fs; $0.50 mf

The photometric function of the moon is used to derive the best lighting and viewing conditions for observation of the lunar surface from orbit. The best pictures are obtained when the sun is about 30° from the horizon and the camera looks away from the sun at an inclination of 30° from the vertical. The discussion and results of this paper are also applicable to the Apollo Command Module, Lunar Excursion Module, and Lunar Reconnaissance Module. Author

N64-33165* Geophysics Corp. of America, Bedford, Mass.
PLANETARY METEOROLOGY Quarterly Progress Report No. 1, 20 Apr.–19 Jul. 1964
[1964] 38 p refs
(Contract NASw-975)
(NASA-CR-58848) OTS: $2.00 fs; $0.50 mf

Subjects covered include radiative equilibrium temperature distribution in the Venus atmosphere, atmospheric circulation on Venus, Martian surface pressure, carbon dioxide, and water-vapor amounts, atmospheric circulation on Mars, and the vertical variation of temperature above clouds of Jupiter. D.E.W.

N64-33173* Georgetown U., Washington, D.C. Georgetown College Observatory
SPECTROSCOPIC STUDY OF SOLAR AND PLANETARY ATMOSPHERES Semi-Annual Status Report, 1 Feb.–1 Aug. 1964
Francis J. Heyden and Carl C. Kiess [1964] 17 p
(Grant NsG-362)
(NASA-CR-58772) OTS: $1.00 fs; $0.50 mf

The absorption bands of nitrogen peroxide were mapped with high dispersion through the region from 3300 Å to 6600 Å. Experimental conditions and procedures are described. During the report period, Jupiter and Mars were unobservable. Observations of Venus were attempted, two for rotational velocity determination and one for the violet "fall off." The methods and results of reductions of spectral observations are presented. The photoelectric spectrum scanner was put in operation, and the instrument is described in detail. D.E.W.

N64-33180* RAND Corp., Santa Monica, Calif.
A SUGGESTED PROGRAM OF ECLIPSE OBSERVATIONS FROM THE MOON
G. F. Schilling Aug. 1964 20 p refs
(Contract NASr-21(09))
(NASA-CR-58778; RM-4249-NASA) OTS: $1.00 fs; $0.50 mf

A brief description is given of a proposed series of unique experiments to be performed on the moon. The relative technical simplicity, yet high scientific value, make it ideally suitable as an early task for Apollo astronauts. The potential advantages are emphasized for adopting eclipse observations as one of the major scientific objectives of the Apollo and post-Apollo programs. D.E.W.

N64-33181* Alabama U. Research Inst., Huntsville
PARAMETER OPTIMIZATION Interim Report No. 3, Mar. 1–Jun. 30, 1964
F. J. Tischer 1 Jul. 1964 54 p
(Contract NAS8-5411)
(NASA-CR-58781) OTS: $3.00 fs; $0.50 mf

The results of studying the effect of measurement errors of the observables on the orbital parameters in general tracking operations are discussed. The equations considered contain only orbital parameters. The distance is normalized with regard to the major axis of the elliptic orbit, which is proportional to the total energy content. The derivations lead to relationships that clearly indicate regions and time periods along the orbit where the tracking errors will become small and also where they will become excessive. An attempt is made to minimize the errors of the orbital parameters caused by deviations of the observed quantities for the geometric case. The observed quantities are three positions along the orbit. Since the practical tracking operations will involve measurements to and from stations on the surface of the earth, coordinate transformations have to be taken into account. A review of the equations by which these transformations can be carried out is presented. P.V.E.

N64-33190* Rensselaer Polytechnic Inst., Troy, N.Y.
CHEMISTRY OF THE ATMOSPHERE OF THE PLANET VENUS Technical Status Report No. 4, 1 Feb.–31 Jul. 1964
P. Harteck, R. R. Reeves, Jr., and Barbara A. Thompson [1964] 6 p ref
(Grant NsG-261-62)
(NASA-CR-59112) OTS: $1.00 fs; $0.50 mf

Three different experimental arrangements were used for the investigation of the emission of microwave radiation by chemical reactions. The first is an ordinary X-band waveguide noise generator with the argon discharge tube replaced by a 6-mm Pyrex tube connected to a vacuum rack. Observed CO_2 and SO_2 intensities were too unreasonably high to be attributed solely to electron temperature. In order to test whether the origin of the emission may be the continua associated with the chemiluminescent reactions occurring in the discharges, a method was developed to see whether such emission could be observed from the reactions alone. This test could not be carried out using the noise generator because the oxygen atoms recombine on the walls of the 6-mm tubing before any glow reaches the detection area. Two alternate systems were set up and are being studied. The results obtained to date indicate that the microwave radiation emitted from Venus may originate in part from a nonthermal source, and thus the surface temperature may be lower than previously reported. Photochemistry experiments using iodine and bromine lamps are also reported. R.L.K.

N64-33221 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEW DATA ON "MARS-1"
28 May 1964 9 p Transl. into ENGLISH from Stinta si Tehnica (Bucharest), no. 2, 1963 p 40–41
(FTD-TT-64-237/1+2+3+4; AD-601509)

This is a description of the cosmic laborato. "Mars I, an automatic interplanetary satellite station, with r ences to some of the new data gathered by it. Mars I con ed two hermetically sealed compartments—the orbital with the instrumentation necessary for functioning during its flight to Mars, and the planetary with the intrumentation geared to the Martian vicinity. New data obtained by the system Mars I pertained to the distribution of charged particles and the plasma layer, and the streams of corpuscles coming from the sun; to the radiation intensity from the earth's radiation belt and from millions

of kilometers' distance, with the discovery of an increase of 50% to 70% intensity of the cosmic radiation stream; magnetic-field variations of 4 to 12 gammas were found at great distances; and a proportional decrease in the number of meteorites to the distance from earth was observed. G.G.

N64-33334* Smithsonian Astrophysical Observatory, Cambridge, Mass

SATELLITE ORBITAL DATA. RESEARCH IN SPACE SCIENCE

Beatrice Miller 27 Jul. 1964 81 p

(Grant NsG-87-60)

(NASA-CR-59294; SAO Special Rept.-160) OTS: $3.00 fs; $0.75 mf

Changes in calculation formulas and the computer program are noted, and smoothed and mean orbital elements and sun-perigee data are given for Explorer I, Vanguard II, Vanguard III, Echo I, Explorer VIII, Explorer IX, Telstar I, Anna 1B, Injun III, Relay I, Explorer XVII, Telstar II, and Geophysics Research satellites. D.E.W.

N64-33385* Consultants and Designers, Inc., Arlington, Va.

MEASUREMENTS AT 8mm OF THE BRIGHTNESS TEMPERATURE OF THE ILLUMINATED SIDE OF VENUS [IZMERENIYA YARKOSTNOY TEMPERATURY OSVESHCHENNOY STORONY VENERY NA VOLUME 8 mm]

A. E. Basharinov, Yu. N. Vetukhovskay, A. D. Kuz'min, V. G. Kutuza, and A. E. Salomonovich 26 Oct. 1964 7 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 41, no. 4, 1964 p 707–710

(Contract NAS5-3760)

(NASA-TT-F-8978; ST-LPS-10228) OTS: $1.00 fs; $0.50 mf

The brightness temperature of Venus, averaged over the disk, was measured at 8 mm near the upper conjunction of 1963 ($k = 0.88 + 0.98$) and was found to be $435° \pm 65°$ K on 10–11 May, $462° \pm 65°$ K on 22–26 July, and $475° \pm 50°$ K on 2–9 October. Author

N64-33406* National Aeronautics and Space Administration, Washington, D.C.

CLARIFICATION ON THE INCLINATION OF THE FRI ORBIT

B. Lago Oct. 1964 6 p Transl. into ENGLISH of "Mise au Point sur l'Inclination de L'Orbite de Fri" Paris, Centre Natl. d'Etudes Spatiales, no. 2s

(NASA-TT-F-9145) OTS: $1.00 fs; $0.50 mf

Several investigators compared their work on the proposed orbital inclination of the FRI Satellite. Discrepancies were found to be due to differences in calculation methods and to the omission of short-period terms in one computer program. The value of the proposed inclination, as found by the corrected calculations, is 75° 7. D.E.W.

N64-33426 Chance Vought Corp., Dallas, Tex. Astronautics Div.

LUNAR FLIGHT MECHANICS STUDY

T. Hammer and R. D. Glenn 1 May 1963 51 p ref

(Rept.-00.237)

This paper is a study of the effects of efficiency-sensitive parameters on lunar vehicle translation. Derivations of the equations governing vehicle motion for constant altitude translation and ballistic translation employing gimbaled or fixed engines are discussed. Author

N64-33489 Defence Research Board, Ottawa (Canada)

CAUSES OF THE LUMINESCENCE OF ROCKS ON THE MOON

N. S. Beskrovny Jan. 1963 3 p refs Transl. into ENGLISH from Prirода (Moscow), v. 12, no. 100, 1962

(T-380-R)

Ultraviolet irradiation studies were made of numerous samples of crystalline rocks originating from deep fracture zones. In 18% to 30% of the samples studied, luminescence was observed, but only in fine cracks in the rocks where petroleum bitumens were later found. These and other correlated findings support expectations that lunar rocks near deep fractures, particularly near the Tycho crater, are enriched with petroleum bitumens or with rare-earth minerals, or both. D.E.W.

N64-33623* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ON THE USE OF SHORT ARCS IN ORBIT DETERMINATION

Hans G. Hertz Jul. 1964 151 p

(NASA-TM-X-55080; X-547-64-191) OTS: $5.00 fs; $1.00 mf

The suggestion that determinations of satellite osculating elements be made from observations of a single station pass means that for one determination the observations over only a short period (a few minutes) would be used. It is concluded that if this is feasible, it would be equally feasible to determine the integration constants from such short arcs. Some results of determination of integration constants from short arcs are presented. The Baker–Nunn observations used were 475 observations of Echo I during the period Aug. 12, 1960 through Aug. 31, 1960. The results indicate that determinations of elements from short arcs of about 1^h4 to 4^h half-arc length need not be less accurate than those obtained from longer arcs, and that the determinations from the short arcs, in addition, offer the advantage of finer resolution. P.V.E.

N64-33624* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

LONG-PERIOD CONTRIBUTIONS TO THE DISTURBING FUNCTIONS OF THE EARTH FROM THE SEVENTH, NINTH, AND ELEVENTH ZONAL HARMONICS

T. L. Felsentreger and W. J. Wickless Aug. 1964 12 p refs

(NASA-TM-X-55090; X-547-64-233) OTS: $1.00 fs; $0.50 mf

It is the purpose of this paper to present explicit formulas for the long-period terms due to the seventh, ninth, and eleventh zonal harmonics in the disturbing function of the earth in the case of an artificial earth satellite. The formulas are given for terms of the satellite's orbital elements and the Delaunay variables. The contributions of the long-period terms to the mean motion of the argument of perigee are also given. Author

N64-33727 Air Proving Ground Center, Eglin AFB, Fla.

TRUMP (INTERIM PHASE) NIKE-CAJUN VERTICAL PROBE (TRUMP VEHICLE) TRAJECTORIES

Ernest T. Scambos Jun. 1964 384 p Supplement to APGC-TDR-64-23

(APGC-TDR-64-38; APGC-TDR-64-23; AD-444191)

This report presents a detailed discussion of the Trump test vehicle, theoretical and actual trajectories, vehicle roll rate, and vehicle fin and body misalignment inspection procedures. Included are the tabulated theoretical trajectory calculations, radar tracking data, range meteorological data, and radar tracking plots for all eleven missions of the series of launches. Author

N64-33807* Northrop Corp., Hawthorne, Calif. Nortronics
INVESTIGATION OF PROBLEMS ASSOCIATED WITH THE DETECTION OF THE LUNAR HORIZON FROM A SPACE VEHICLE Monthly Progress Report, 1 Apr.–1 May 1964
W. Palser 7 May 1964 3 p
(Contract NAS8-11039)
(NASA-CR-58762; NORT-63-355/10) OTS: $1.00 fs; $0.50 mf

The Barnes thermopile test program was completed; the necessary electronics were fabricated and assembled to compare the two signals from a simulated pair of thermopiles; and modification of the electronics to incorporate field-effect transistors is planned for the delivery date of the transistors. Other details of documentation and manpower budgeting are included. D.E.W.

N64-33902* United Aircraft Corp., East Hartford, Conn. Research Labs.
OPTIMAL VARIABLE-THRUST RENDEZVOUS OF A POWER LIMITED ROCKET BETWEEN NEIGHBORING LOW-ECCENTRICITY ORBITS Final Report
F. W. Gobetz Oct. 1964 69 p refs
(Contract NAS8-11099)
(NASA-CR-59392; C-910098-12) OTS: $3.00 fs; $0.75 mf

Complete analytical solutions are obtained in three different sets of variables—rotating rectangular coordinates, rotating spherical coordinates, and Lagrange's planetary variables. In addition to the determination of optimal transfer and rendezvous trajectories in three dimensions, synthesis of the optimal controls is also carried out in each case. The guidance coefficients resulting from the control synthesis are presented both in graphical form and in equation form suitable for use in guidance applications. The use of an intermediate reference orbit is found to be a powerful method of improving the accuracy of the linearized theory. Results for circular, coplanar Earth–Venus and Earth–Mars transfers are compared with exact solutions. The linear theory is shown to provide a very good correlation with exact data for all trip times of interest. Author

N64-33988* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LIFETIME IN SPACE OF POSSIBLE PARENT MOLECULES OF COMETARY RADICALS
A. E. Potter and Betty Del Duca Repr. from Icarus, v. 3, no. 2, Jul. 1964 p 103–108 refs
(NASA-RP-351)

The space lifetimes for some possible parent molecules (ethylene, acetylene, methane, acetonitrile, monocyanoacetylene, dicyanoacetylene, cyanogen, methylamine, hydrazine, ammonia, hydrogen peroxide, and water) of the radicals in comets were estimated from laboratory measurements of absorption cross sections and the solar ultraviolet flux. The lifetimes at 1 au for possible C_2 and CN parent molecules were much greater than the 1- to 3-hr lifetimes deduced from astronomical observations. This result is interpreted to mean that, if the parent molecules exist, they are probably not species stable at room temperature. Author

N64-33989* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVOLUTION OF O STARS. II: HYDROGEN EXHAUSTION AND GRAVITATIONAL CONTRACTION
Richard Stothers Repr. from Astrophys. J., v. 140, no. 2, 15 Aug. 1964 p 510–523 refs
(NASA-RP-352)

The evolution of a star of 30 $M_\odot$ from the end of the stable phase of hydrogen burning to the onset of helium burning is considered. Ten models are constructed for the hydrogen-exhaustion (E) phase and six models for the gravitational contraction (G) phase. It is stated that the time scale of the E-phase is so short (8.8×10^4 years) that the shell source remains peaked at $q = 0.34$ and undergoes little hydrogen depletion. Because radiation pressure remains strong in the core, convection does not vanish when the hydrogen content at the center falls to zero. Gravitational contraction of the core contributes more to the luminosity than shell burning, but, since the total luminosity changes little, the structure of the envelope is hardly affected. The G-phase begins when $L_{H,\,core}/L < 0.001$, and lasts 9×10^3 years. Although the temperature in the shell increases, hydrogen depletion remains negligible because of the short time scale. IAA

N64-33991* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIFFERENCES IN THE CHARACTER OF C_6 TO C_9 HYDROCARBONS FROM GASEOUS METHANE IN LOW-FREQUENCY ELECTRIC DISCHARGES
Cyril Ponnamperuma and Fritz Woeller Repr. from Nature (London), v. 203, no. 4942, 18 Jul. 1964 p 272–274 refs
(NASA-RP-361)

The action of several arc discharges on gaseous methane are discussed. Four types of arcs are considered—high, continuous arc; high, pulsed arc; low, continuous arc; and semicorona continuous. In the high-intensity arc, the distillate obtained from the discharge cell was a clear yellow fluid that gave chromatograms of well-spaced peaks. Benzene was most abundant, with toluene being next in abundance. The semicorona cell yielded a colorless distillate, the gas chromatogram of which was poorly resolved. A significant feature of this chromatogram was the virtual absence of any peaks indicating the presence of benzene or toluene. The low-intensity arc produced a mixture, the chromatogram of which was similar to that of the semicorona; however, benzene and toluene were found present in small quantities. The results presented show that the character of compounds found in the cells after discharge appears to be determined by the type of discharge more than by any other factor. P.V.E.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see:* 31 Space Vehicles (Launch Vehicles). *For related information see:* 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-32878 Eurospace, Paris (France)
AEROSPACE TRANSPORTER
E. Sanger 1964 57 p

This is a report of a program-development concept for an aerospace transporter that is capable of takeoff from a conventional airfield, is able to fly hypersonically to distant points on the earth's surface or in orbit, is useable for transportation, and finally is able to glide back to earth and to land on an airfield. G.G.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-32926 McDonnell Aircraft Corp., St. Louis, Mo.
ASSET PROGRAM Monthly Progress Letter, 1–30 Jun. 1964
[1964] 30 p
(Contract AF 33(616)-8106)
(MPL-26; AD-287805)

The MST-4 was successfully completed on ASV-3 at the Cape. A vibration measuring system was added in the interstage of ASV-3 to measure accelerations during boost. The final flight trajectory parameters have been determined for the ASV-3 (38/18) and have been transmitted to ETR on the magnetic tape that combines the boost and glide trajectories. The final range safety and dispersion data for ASV-3 (38/18) have also been transmitted to ETR. AEV-1 upper body was fitted to the lower body and the preliminary weight and balance check was completed. Flutter panel module S/N 2 is presently installed in AEV-1 and has been operated through the vehicle electrical system during the instrumentation testing, which is now in progress. Author

N64-33158* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CORRELATION OF LAUNCH-VEHICLE WIND-TUNNEL AERODYNAMIC NOISE WITH SPACECRAFT FLIGHT VIBRATION DATA (REVISION NO. 1)
Robert A. Schiffer 15 Sep. 1964 12 p refs Revision of JPL-TR-32-619; see N64-19898 12-23
(Contract NAS7-100)
(NASA-CR-58776; JPL-TR-32-619, Rev. 1) OTS: $1.00 fs; $0.50 mf

It has been observed that the maximum vibration levels experienced by a launch vehicle occur in the regions of q_{max} and transonic flight. Flight-vibration data from Ranger spacecraft launches 1 through 6 have been correlated with available wind-tunnel fluctuating pressure data at transonic speeds in order to develop a technique for vibration prediction for types of vehicles that have not previously been flown. Statistical analysis of the wideband vibration data suggests a linear correlation with the wind-tunnel wideband fluctuating-pressure data. Correlation is also explored between the average vibration response spectra calculated by using the empirical method suggested by P. Franken and the 50-percentile log-normal acceleration confidence level obtained by spectral analysis of the flight data. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-32859 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
DATA REPORT OF THE METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME III: SUMMER 1960 FIRINGS
Jun. 1964 250 p
(IRIG-109-62; AD-449617)

This is a meteorological data presentation for summer 1960, from various earthbound weather stations utilizing several meteorological rocket systems. The chaff dispersion and fall rate of Loki I, Loki II, Arkas, and the Arkas–Robin configuration are discussed. The wind and altitude data were obtained by radar plotting grids, and the wind profiles were gained by computation of data gathered in 1-minute time intervals. The temperature values were observed by a radiosonde transmitter unit, and were recorded in raw form. G.G.

N64-32869 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
METEOROLOGICAL ROCKET NETWORK FIRINGS DATA REPORT. VOLUME XIV: OCTOBER 1962 FIRINGS
May 1964 284 p
(IRIG-109-62; AD-449616)

This is a collection of meteorological data obtained by wind and temperature measurements from rocket firings and radiosonde observations, ±6 hours from time of firing, from 10 meteorological-rocket network stations. G.G.

N64-32948* National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH BEACON EXPLORER; WILL TEST LASER News Release No. 64-237
4 Oct. 1964 37 p
Available from the Scientific and Technical Information Division

This paper describes three types of ionospheric satellites—the direct-measurement Explorer satellite, the topside sounder, and the beacon Explorer satellite. Special emphasis is placed on the development and construction of the beacon Explorer satellite, its provisions for radio transmissions at wavelengths that penetrate through the ionosphere to the ground, the reflection system for earth-generated laser beams, and the electrostatic measurement system of the electron density and temperature in the spacecraft's immediate vicinity. The multistage, four-motor scout launch vehicle is also described. G.G.

N64-32999* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE ELECTRICALLY PROPELLED LUNAR LOGISTIC VEHICLE
R. Rhoads Stephenson 1 Oct. 1964 20 p refs
(Contract NAS7-100)
(NASA-CR-58972; JPL-TR-32-659) OTS: $1.00 fs; $0.50 mf

A parametric analysis of an electrically propelled lunar logistic system is presented. A performance index, which is the ratio of the gross payload delivered to lunar orbit during the lifetime of the nuclear-electric powerplant to the total weight placed into the initial earth orbit during the same period of time, is evaluated. Curves describing the performance index as a function of the powerplant mass fraction (and the corresponding thrust device specific impulse) for various round-trip flight times and powerplant lifetimes are presented. For any given case, there is an optimum allocation of mass to the powerplant, and these optima are presented in summary curves showing the best performance index obtainable with a given powerplant specific weight for a specified flight time and powerplant lifetime. Author

N64-33046* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NUMBER 16
31 Aug. 1964 14 p
(NASA-TM-X-54783; X-533-63-1) OTS: $1.00 fs; $0.50 mf

N64-33063* National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH METEOROID DETECTION SATELLITE ATWALLOPS News Release No. 64–272
2 Nov. 1964 14 p Available from the Scientific and Technical Information Division

According to NASA, a satellite is to be launched that is specifically designed to gather information on the hazards from minute particles in space travel. The direct experimental data gathered from this satellite will be used for the efficient design of spacecraft structures in order to withstand meteor penetration, for the determination of the effects of high-energy radiation, and for measuring air loads on the vehicle during its ascent through the atmosphere between 25 000 and 40 000 feet. An instrumentation description for future experiments is given. G.G.

N64-33175* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NUMBER 15
15 Aug. 1964 13 p
(NASA-TM-X-51984; X-533-63-1) OTS: $1.00 fs; $0.50 mf

N64-33177* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PROTECTION REQUIREMENTS FOR THE RESISTANCE OF METEOROID PENETRATION DAMAGE OF INTERPLANETARY SPACECRAFT SYSTEMS
John J. Volkoff 1 Jul. 1964 43 p refs
(Contract NAS7-100)
(NASA-CR-59205; JPL-TR-32-410) OTS: $2.00 fs; $0.50 mf

A study of spacecraft component and system protection requirements for the resistance of meteoroid penetration damage is presented for various planetary and interplanetary missions. Meteoroidal characteristics and their distributions in planetary, asteroid belt, and interplanetary space regions are discussed. A meteoroid model derived from this study is applied to typical missions for nuclear-electric spacecraft, and corresponding meteoroid flux-intensity profiles are determined. A technique to estimate the armor requirement for any interplanetary mission is developed and discussed. The armor requirement for interplanetary missions is compared to that for near-earth conventional estimates and is applied to the radiator systems of a conceptual 500-kWe nuclear-electric spacecraft. Author

N64-33328* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MISSION PLAN TIROS VI
Aug. 1962 103 p
(Proj. Tiros)
(NASA-TM-X-54785; X-650-62-65) OTS: $4.00 fs; $0.75 mf

The TIROS meteorological satellite is designed to obtain television data of extremely wide coverage. A Thor–Delta vehicle launched from the Atlantic Missile Range will place the satellite in a nominal circular 350-nautical-mile 58-degree orbit, with the spin axis at minimum nadir angle of 28.8 degrees north latitude. The Minitrack network will track the satellite. The NASA Computing Center will provide ephemeris information and illumination and earth-aspect data, which will be converted to data-collection programs by the TIROS Technical Control Center and sent to the primary command stations for transmission to the satellite. Observed cloud-information data will be received from the satellite, recorded, and transmitted to the agencies responsible for processing and evaluation. The mission plan describes the TIROS organization, provides a directory of personnel, summarizes the objectives, launch and postlaunch operations, and gives detailed descriptions of the spacecraft, command and data-acquisition stations, and attitude-recording station. R.L.K.

N64-33403* National Aeronautics and Space Administration, Washington, D.C.
VALUE OF A EUROPEAN SATELLITE FOR TELEVISION BROADCASTING [INTERET D'UN SATELLITE EUROPEEN DE DIFFUSION DE TELEVISION]
G. Plottin Oct. 1964 19 p refs Transl. into ENGLISH of a Report No. 5.023/R of Compagnie Gen. de Telegraphie sans Fil, 25 Nov. 1963 23 p
(NASA-TT-F-9138) OTS: $1.00 fs; $0.50 mf

Because of the large number of transmitting stations and microwave-link relays required for television broadcasting, due to the limited range of uhf waves, the use of a reflecting "cat's eye" satellite in a stationary equatorial orbit is suggested for European television. Such a satellite consists of a large reflector that intercepts the major part of the main beam radiated from a ground transmitter and reflects the energy in the incident direction. A country the size of France could be covered by a single transmitter at its geographical center. Since the satellite is passive, it could be used simultaneously for all the European nations and for several programs. It would be independent of the television systems and could be used for Eurovision retransmission and by other networks, such as telephone and press wire services. R.L.K.

N64-33552 Bendix Corp., Ann Arbor, Mich. Systems Div.
FLARE ACTIVATED RADIOBIOLOGICAL OBSERVATORY SATELLITE DESIGN STUDY DRAFT Final Report
L. R. Lewis, W. E. Crosmer et al Kirtland AFB, N. Mex., AF Weapons Lab., Aug. 1964 339 p refs
(Contract AF 29(601)-6001)
(AFWL-TDR-64-67; AD-607601)

A satellite system design study was performed to determine the characteristics required of a satellite to evaluate the solar flare and radiation belt hazard to near-earth manned space missions. The study uncovered possible problem areas and investigated their solutions. Scientific instrument payloads were selected to measure radiation parameters of significant importance. Tradeoff studies among the system parameters were performed, and system designs were recommended. A preliminary design was undertaken in each satellite subsystem area; two satellite designs were developed. The first was a sophisticated 450-pound satellite compatible with the Delta DSV-3B launch vehicle, and the second was a simplified 150-pound version compatible with the Scout (SLV-1A) vehicle. Author

N64-33563* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SATELLITE SYSTEM FOR RADIO ASTRONOMICAL MEASUREMENTS AT LOW FREQUENCIES
J. K. Alexander and R. G. Stone Aug. 1964 18 p Presented at the IAU Symp. No. 23 on Astron. Observations from Space Vehicles, 20 Aug. 1964
(NASA-TM-X-55089; X-615-64-220) OTS: $1.00 fs; $0.50 mf

By utilizing long (250m) antenna elements with a terminating resistance placed an odd number of quarter-wavelengths from the end, a V-antenna can be formed having a beamwidth

less than 30° and an 18-dB front-to-back ratio over a band of frequencies near 5 Mc/sec. Proper combinations of four such long elements in a double-V or X configuration, furthermore, can be made to yield some gain over a dipole for observations as low as 0.3 Mc/sec. A step-frequency, Ryle–Vonberg radiometer that employs an all-solid-state-component comparison noise source has been developed to perform over a 70-dB dynamic range with a relative accuracy of ±0.5 dB. A simple, precise instrument to measure both the resistive and reactive components of antenna impedance has also been developed for satellite use. Observations with this system from a gravity-gradient stabilized spacecraft in a 6000-km orbit would afford significant contributions to galactic studies, solar physics, and planetary astronomy by extending radio observations to frequencies in the range 0.3 to 10 Mc/sec. Author

N64-33638* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE ELECTRICALLY PROPELLED LUNAR LOGISTIC VEHICLE
R. Rhoads Stephenson New York, AIAA [1964] 16 p refs Presented at 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(Contract NAS7-100)
(AIAA Paper-64-497) AIAA: $0.50 members; $1.00 nonmembers

A performance index, which is the ratio of the gross payload delivered to lunar orbit during the lifetime of the nuclear-electric powerplant to the total weight placed into the initial earth orbit during the same period of time, is evaluated. Curves describing the performance index as a function of the powerplant mass fraction (and the corresponding thrust device specific impulse) for various round trip flight times and powerplant lifetimes are presented. For any given case, there is an optimum allocation of mass to the powerplant, and these optima are presented in summary curves showing the best performance index obtainable with a given powerplant specific weight for a specified flight time and powerplant lifetime. For first-generation powerplants, which may be heavier and have a shorter lifetime than ultimately expected, one-way trips may be desirable, and applicable results are presented. Author

N64-33740* National Aeronautics and Space Administration, Washington, D.C.
SPACE, THE NEW FRONTIER
James Dean, George Gardner, Bernard Luchton, Victor Seigel, and Elbert Umsted 1964 72 p ref
(EP-6 REV.) GPO: $0.50

Important benefits of the hard-driving space program now underway are these: (1) development of high-thrust boosters with greater payload capabilities; (2) superior guidance and control; (3) establishment of a structure of massive ground facilities to assemble, test, and launch space vehicles for future needs; (4) development of a strong industrial base for any space systems requirements; (5) training of scientists and engineers in basic research; (6) support of predoctoral training grants; (7) development of great scientific competence in universities and research laboratories; and (8) establishment of a reservoir of technicians in industry, and training of astronauts and military personnel for future space needs. P.R.D.

N64-33770* Bell Aerosystems Co., Buffalo, N.Y.
FEASIBILITY STUDY FOR A LUNAR LANDING FLIGHT RESEARCH VEHICLE
8 Mar. 1962 233 p *Its* Rept. 7161-950001
(Contract NAS4-174)
(NASA-CR-59328) OTS: $6.00 fs; $1.50 mf

The purpose of the study was to establish the characteristics and to conduct a preliminary design of a free-flight lunar-landing research test vehicle. A study of basic lift methods indicates that a vehicle using a combination of one turbofan jet engine and hydrogen peroxide rockets can provide a reasonable simulation of a manned lunar landing and can be produced at a minimum of time and cost. A preliminary design of a one-man research vehicle is presented, including a description and analysis of the open truss-type structure and of the propulsion, flight control, cockpit, and electrical systems. A vehicle stability and performance analysis is included. A study of reliability, safety, support equipment and facility requirements, wind-tunnel requirements, schedule, cost, and future growth is presented. Author

N64-33813* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-29, VOLUME VI FOR THE PERIOD JULY 1, 1964–AUGUST 31, 1964. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
W. H. Pickering 30 Sep. 1964 65 p refs
(Contract NAS7-100)
(NASA-CR-59340; JPL-TR-37-29; Vol. VI) OTS: $3.00 fs; $0.75 mf

In this report concerning the space-exploration programs and the space sciences, the following topics are discussed: "Lunar Programs"—the Ranger Program, and the Surveyor Project; "The Planetary–Interplanetary Program"—the Mariner Project; "The Deep Space Network"—the deep space instrumentation facility, and the space-flight operations facility; and "The Space Sciences"—the space-instrument development." G.G.

N64-33830* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
METEOROLOGICAL SATELLITE DATA SYSTEMS
Herbert Butler Sep. 1964 28 p
(NASA-TM-X-55093; X-650-64-241) OTS: $2.00 fs; $0.50 mf

Some of the key elements or variables are identified and examined that are a part of the complex matrix that must be solved to produce an effective system design, and the solution of such a matrix for one of the forthcoming TIROS satellites is illustrated. Stabilization systems considered include only positive attitude-control systems and gyroscopic spinning of spacecraft. Subjects discussed include objectives, equatorial and polar orbits, sensor platforms, sensors, ground stations, and TIROS I. D.E.W.

N64-33847 Defense Documentation Center, Alexandria, Va.
ECHO COMMUNICATION SATELLITE Bibliography, Dec. 1959–Nov. 1963
Esther E. Thompson, comp. Nov. 1963 24 p refs
(AD-422849)

N64-33856* National Aeronautics and Space Administration, Washington, D.C.
MARINER MARS 1964 MISSIONS SCHEDULED FOR EARLY NOVEMBER News Release No. 64-266
29 Oct. 1964 80 p
Available from the Scientific and Technical Information Division

According to the National Aeronautics and Space Administration, the United States will undertake the most difficult mission yet in its program of unmanned space exploration. Two identical Mariner spacecraft will be launched by NASA from Cape Kennedy, Florida, toward the planet Mars within

a monthlong period, beginning no earlier than November 4, 1964. The flight distance to Mars is some 350 million miles compared with 180 million miles for the 1962 Mariner II flight past Venus. The Mars flight time is about 8 1/2 months as compared with the 3 1/2 months for Mariner II. Some 138 000 components in each Mars Mariner will have to function some 6500 hours in space. Because of the difficulty of the mission, new engineering applications required for this mission include use of an improved propellant system for the Agena D launch vehicle second stage, a new spacecraft radio system, the first use of the star Canopus for spacecraft attitude reference, and a midcourse motor capable of firing twice. P.V.E.

N64-33938 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FIRST SPACE FLIGHT AND RADIO ELECTRONICS
S. I. Siforov 21 Sep. 1964 7 p Transl. into ENGLISH from Vestn. Svyazi (Moscow), no. 7, 1961 p 5–6
(FTD-TT-64-409/1; AD-607129)

Various ways in which radio technology plays an important role in the exploration and investigation of space are discussed. These include determining the position of a spaceship, communications, establishment of distances, and making astronomical measurements. P.V.E.

N64-34005* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THERMAL DESIGN AND THERMAL DATA ANALYSIS OF SA-5 PAYLOAD
Tommy C. Bannister and Cliff L. Lumpkin 3 Jul. 1964 28 p ref
(NASA-TM-X-53074) OTS: $2.00 fs; $0.50 mf

The payload consisted of the S-IV stage, the IU (instrument unit), the adaptor, and a Jupiter nose cone. Inside the adaptor was a beacon transmitter whose power supply was batteries located in the nose cone. Temperature specifications on the batteries and the transmitter required thermal control in orbit. The specifications were as follows: beacon transmitter range, −10° to 75° C; and nose-cone batteries range, −20° to 75° C. The in-flight temperature measurements (of these two components) show that the temperatures remained within the following ranges: beacon transmitter range, −4° to 13° C, and nose-cone battery range, 4° to 20° C. This report presents the thermal requirement of the SA-5 payload, the thermal design, the flight data, and postlaunch analysis. Author

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-32789* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RECENT DEVELOPMENTS IN SPACE POWER SYSTEM METEOROID PROTECTION
Irvin J. Loeffler, Nestor Clough, and Seymour Lieblein N.Y., AIAA [1964] 21 p refs Presented at the Third Bien. Aerospace Power Systems Conf. (AIAA/SAE/ASME/IAPG/Electron Devices Group IEEE), Philadelphia, 1–4 Sep. 1964
(NASA-TM-X-52051; AIAA Paper-64-759) AIAA: $0.50 members; $1.00 nonmembers

Recent advances in meteor astronomy, satellite experiments, and hypervelocity impact are reviewed. Perhaps the most important advances have been made in the area of the meteoroid environment. The application of the results of the Trailblazer I artificial meteor experiment and the analysis of three asteroidal particle observations by Whipple have led to the establishment of new values of large-particle-mass meteoroid flux and density that have been widely accepted. A tentative new meteoroid environment model is discussed that largely resolves the major discrepancies in the flight experiment and zodiacal cloud data and appears consistent with physical and theoretical considerations. The new model includes a geocentric distribution of low-velocity earth-orbiting small particles in addition to the generally recognized heliocentric distribution. Author

N64-32810 Brown U., Providence, R.I. Engineering Div.
BOUNDS ON THE RATE OF ENERGY DISSIPATION IN BODIES DEFORMING BY SECONDARY CREEP
W. R. Hodgkins Aug. 1964 23 p refs
(Contract Nonr-562(20))
(TR-38; AD-605450)

The present note extends previous methods of bounding the rate of energy dissipation in a body deforming under secondary creep according to a power law $\epsilon = b\sigma^n$. By an appropriate definition of the "representative stress," bounds for a material with an arbitrary value of n are expressed in terms of a postulated known solution to the identical stress-loading problem for a material with a different value of n. The results are applied first to idealized materials where n is a constant, and then extended to a class of nonidealized materials where n is a monotonic increasing function of stress. Author

N64-32840* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INFLUENCE OF RING STIFFENERS ON INSTABILITY OF ORTHOTROPIC CYLINDERS IN AXIAL COMPRESSION
David L. Block Washington, NASA, Oct. 1964 22 p refs
(NASA-TN-D-2482) OTS: $0.50

Calculations are presented from an analytical investigation on the influence of ring stiffeners on the instability modes of orthotropic cylinders subject to compressive or bending loads. The analysis is performed by employing small-deflection theory and by modifying the equilibrium equation to include the effects of discrete ring stiffeners characterized by a bending stiffness that restrains radial deformation of the shell. These calculations indicate that the ring bending stiffness necessary to cause panel instability can be adequately determined by use of an analysis that does not include the discreteness of the rings. Comparison of the results of the calculations with an empirical ring-design criterion in common use indicates that the empirical formula can be either very conservative or very nonconservative depending on the cylinder geometry. Author

N64-32885* Rice U., Houston, Tex.
NONELASTIC STRAIN RECOVERY OF COPPER SINGLE CRYSTALS AFTER SMALL PRESTRAINS
J. M. Roberts and D. M. Barnett [1964] 5 p refs Submitted for Publication
(Grant NsG-6)
(NASA-CR-58782) OTS: $1.00 fs; $0.50 mf

By the use of mathematical equations, it is shown that the magnitude of the nonelastic strain recovery of copper after small prestrains appears to be primarily related to the dislocation density of the crystal at the time of stressing and

is not appreciably sensitive to the distance over which they can move. E.C.

N64-32953 Southwest Research Inst., San Antonio, Tex.
AN EXPERIMENTAL INVESTIGATION OF DYNAMIC MATERIAL PROPERTIES Final Report
U. S. Lindholm Sep. 1964 22 p refs
(Contract DA-23-072-ORD-1674)
(AD-448241)

Fundamental laws governing the rate of deformation of metals have been examined in light of the experimental results obtained. The work on materials in uniaxial compression using the split Hopkinson pressure-bar technique is summarized. The dynamic biaxial-testing machine for the study of the response of materials subject to two-dimensional stress fields is described in detail, and preliminary results are given for a mild steel that exhibits a sharp yield point and a relatively high strain-rate sensitivity. D.S.G.

N64-32975 Toronto U. (Canada) Inst. for Aerospace Studies
TURBULENCE-INDUCED PANEL VIBRATION
M. Y. El Baroudi Feb. 1964 90 p
(Contract AF 49(638)-249; Grants AF AFOSR-6Z-267; DRB-9551-02)
(AFOSR-64-0883; UTIAS-98; AD-448045)

Motivated by the problem of boundary-layer-induced panel noise, a detailed study has been made of the transverse vibration of 11 X 11 inch steel panels flush mounted in the wall of a turbulent flow duct. Panel thicknesses were 0.002 and 0.008 inch. Duct cross sections were 1 X 12 and 8 X 12 inches, and flow speeds were about 60 to 200 fps. The characteristics of the exciting pressure field at the wall and of the resultant vibration of the sample panels were investigated using statistical techniques. Relief charts of the experimental two-point space–time correlation of panel vibration versus longitudinal separation and time delay showed pronounced oblique ridges and valleys discernable in a more random pattern. These are interpreted as running waves (with a speed equal to that of the pressure field convection) with an irregular pattern superposed. Author

N64-33008 Argonne National Lab., Ill.
BENDING OF CIRCULAR PLATES UNDER A UNIFORM LOAD ON A CONCENTRIC CIRCLE
J. C. Heap Apr. 1964 43 p refs
(Contract W-31-109-ENG-38)
(ANL-6905) OTS: $1.00

The basic equations of deflection, slope, and moments for a thin, flat, circular plate subjected to a uniform load on a concentric circle were derived for four generalized cases. From these generalized cases, six simplified cases were deduced. The four generalized cases have the uniform load acting on a concentric circle of the plate between the inner and outer edges, with the following boundary conditions: (1) outer edge supported and fixed, inner edge fixed; (2) outer edge simply supported, inner edge free; (3) outer edge simply supported, inner edge fixed; and (4) outer edge supported and fixed, inner edge free. Author

N64-33022 Brown U., Providence, R.I. Div. of Engineering
STRESS CONCENTRATION IN NON-LINEAR CREEP OF A SIMPLE SHELL
C. R. Calladine Dec. 1963 22 p refs
(Contract Nonr-562(20))
(Nonr-562(20)/36; AD-600082)

A long, thin, circular cylindrical shell is loaded at one edge by symmetrical radial shear Q_x and bending moment M_x (no interior pressure). The shell is made of material that, under applied stress, creeps with a strain rate that is proportional to the rth power of the stress. Previous results are used to derive, approximately, the greatest stress in the shell for any Q_x, M_x and r. It is shown that for any edge load the greatest stress decreases as r increases, and is approximately a linear function of 1/r. The case r = 1 is exactly analogous to a linear elastic problem, and the case $r \to \infty$ corresponds exactly to a perfectly plastic problem; results for any exponent r may thus be found approximately by simple interpolation between results obtained in linear-elastic analysis and perfectly plastic analysis. Author

N64-33031 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ENGINEERING COLLECTION Selected Articles
27 Dec. 1963 20 p refs Transl. into ENGLISH from Inzh. Sb. (Moscow), v. 25, 1959 p 92–103
(FTD-MT-63-136; AD-449227)

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1. FLUTTER OF CYLINDRICAL PANELS MOVING IN A GAS R. D. Stephanov p 1–12 refs (See N64-33032 24-33)
2. STABILITY OF FASTENED PANEL IN SUPERSONIC FLOW K. K. Livanov p 13–16 refs (See N64-33033 24-33)

N64-33032 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FLUTTER OF CYLINDRICAL PANELS MOVING IN A GAS
R. D. Stepanov *In its* Eng. Collection 27 Dec. 1963 p 1–12 refs (See N64-33031 24-33)

The Galerkin method is applied to the solution of the flutter problem of a circular cylindrical shell of open profile, moving in a gas with supersonic speed. It is assumed that the shell on its limiting longitudinal and transverse margins has hinged immobile fastenings in the planes of these margins. Equations of equilibrium of the shells are assumed in accordance with Vlasov's general technical theory of sloping shells. The aerodynamic forces acting on the shell are presented by formula. Author

N64-33033 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STABILITY OF FASTENED PANEL IN SUPERSONIC FLOW
K. K. Livanov *In its* Eng. Collection 27 Dec. 1963 p 13–16 refs (See N64-33031 24-33)

The behavior of eigenvalues in the problem of flutter around a rectilinear panel fastened along the entire contour, moving in a gas with supersonic speed, is investigated by the Galerkin method. The investigation is conducted by taking into account the forces of excess pressure from the direction of the gas by A. A. Ilyushin's law of flat sections. In earlier works, cases of fastening the sides of plates were considered, which admitted accurate solutions. In this work, the form of the characteristic determinant is investigated, and numerical examples are presented to show the similarity of the approximations of the Galerkin method. Author

N64-33075 Martin Co., Orlando, Fla. Materials Research Lab.
MEASUREMENT OF RESIDUAL STRESS BY X-RAY DIFFRACTION Technical Report No. 7
A. L. Esquivel and H. M. Otte Jun. 1964 27 p refs Presented at Southern Metals/Materials Conf., 16–17 Apr. 1964 Submitted for Publication
(Contract Nonr-3706(00))
(OA-2067; AD-602114) OTS: $2.00

For the measurement of residual stresses, X-ray diffraction is potentially the best nondestructive method available. Experiments are described in which silicon-bronze and alpha-brass samples were examined by X-rays while subjected to tensile deformation. The positions of the diffraction lines and their breadths were measured and analyzed. The special features of the experimental arrangement employed are presented, and the method of analysis is explained. An important result of this study is the observation that the stress–strain curve obtained from the X-ray diffraction measurements follows the stress–strain curve obtained from a standard tensile test. Furthermore, for materials that may form stacking faults upon deformation, the X-ray data must first be corrected for the effects produced from stacking faults before the stress is calculated. Author

N64-33149 Army Missile Command, Huntsville, Ala. Structures and Mechanics Lab.

ENERGY SOLUTION TO BUCKLING OF SPHERICAL SHELLS BY USE OF THE RITZ METHOD

G. E. Patrick, Jr. 31 Jan. 1964 18 p refs
(RS-TN-64-1; AD-601045) OTS: $1.00

A closed solution was developed to calculate the critical buckling load of a uniformly loaded sphere, yielding results that are in close agreement with test. This procedure permits the calculation of buckling loads of spherical shells with varying shell segments, varying loading (provided axisymmetric and radial), and a varying thickness. Author

N64-33192* IIT Research Inst., Chicago, Ill.

BREATHING VIBRATIONS OF PRESSURIZED PARTIALLY FILLED TANKS

Ernesto Saleme and Theodore Liber [1964] 8 p refs
(Contract NAS8-11015)
(NASA-CR-58943) OTS: $1.00 fs; $0.50 mf

The differential equations of motion are established, within the scope of the linear small displacement theory, for an axisymmetric pressurized shell filled with one or more nonmixable, nonviscous, compressible fluids. For a given circumferential mode shape there are, in general, several levels of the separation surface associated with the same natural frequency. However, if the liquid level is also prescribed there may not exist a corresponding natural frequency. When two fluids are present in the shell, for the axisymmetric case, the frequencies are grouped into a low and a high range. C.C.

N64-33254 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services

TORSION OF A HOLLOW BAR OF RECTANGULAR CROSS SECTION [KRUCHENIE POLOGO STERZHNYA PRYAMOUGOL'NOGO SECHENIYA]

V. I. Yakovleva Sep. 1964 8 p refs Transl. into ENGLISH from Uch. Zap. Azerb. Gos. Univ., Ser. Fiz.- Mat. i Khim. Nauk (Baku), v. 5, 1960 p 3–7
(TIL/T-5488)

A function $\omega(\zeta)$ is given that describes a ring bounded by concentric circles of radii $R_1 = 1$ and $R_2 = 0.5$ to an area S, the outside contour of which is L_1 and the inside contour is L_2. The torsion due to a moment M_k of a prismatic bar whose cross section is represented by S is examined, and the stresses along the contours L_1 and L_2 of the section are determined. It was found that the maximum stresses in both contours occur at a bend angle of 90° as measured from the center of the longer axis. P.V.E.

N64-33280* Space Technology Labs., Inc., Redondo Beach, Calif.

STABILITY OF AXIALLY-LOADED THIN CYLINDRICAL SHELLS UNDER DYNAMIC LATERAL PRESSURES: BUCKLING OF SHELLS UNDER DYNAMIC LOADS Final Report

Leslie R. Koval and James P. O'Neill Oct. 1963 67 p refs
Its Rept-8688-6004-RU000
(Contract NASw-504)
(NASA-CR-58949; EM-13-20) OTS: $3.00 fs; $0.75 mf

The results of a theoretical and experimental study of the stability of an axially loaded thin cylindrical shell under dynamic lateral pressures are presented and discussed. The theoretical study uses nonlinear shallow shell theory to investigate the coupling between an axisymmetric "ring-type" mode and the asymmetric "breathing mode" into which the shell will initially buckle. It is shown that, under certain conditions when the ring mode is dynamically excited, it may be possible to induce buckling at a dynamic critical pressure that is smaller than the static buckling pressure for shells having R/h ratios < 200. Author

N64-33298 Stanford U., Calif. Engineering Mechanics Div.

MOVING CONTACT PROBLEMS OF A RIGID PROFILE ON A VISCOELASTIC BASE

J. N. Goodier and C. B. Loutzenheiser Jul. 1964 185 p refs
(Contract Nonr-225(29))
(TR-148; AD-605361)

Two-dimensional steady-state solutions (suitable for computer evaluation) are given for moving normal contact loads (sliding or rolling) on the surface of a semi-infinite viscoelastic base, without restriction to simple profiles (e.g., circular cylinders) or to the simplest viscoelastic media (e.g., a single relaxation time, same behavior in shear and dilation). Examples worked out include the following: (1) the rigid cylinder rolling on a material having five relaxation times; and (2) the flat punch with corners rounded to eliminate infinite pressures. The results for (1) show that the variation of rolling resistance over a range of velocities becomes smoother with the greater number of relaxation times. The results for (2) show the dependence of the pressure peaks, near the ends of the contact, on the nature of rounding of the corners and the tilt of the punch. Three-dimensional solutions are considered for the purely viscous material. There is a steady state for a base of finite thickness, but not for the semi-infinite base. Author

N64-33321 Columbia U., New York, N.Y. Inst. for the Study of Fatigue and Reliability

DEVELOPMENT OF RANDOMIZED LOAD SEQUENCES WITH TRANSITION PROBABILITIES BASED ON A MARKOV PROCESS

R. A. Heller and M. Shinozuka Jun. 1964 21 p refs
(Contract Nonr-266(91))
(TR-4; AD-607221)

The reliability of cumulative damage rules, and fatigue life estimates of aircraft structures and components, subjected to variable amplitude service loads, are presently based on programed fatigue tests. The most frequently utilized load sequences—up, down, up-and-down, and randomized steps—are either unrealistic or difficult to apply in testing machines. A time series, combining the advantages of both randomized and programed sequences while avoiding the disadvantages of both, is presented based on the mathematical model of a Markov chain. Author

N64-33322 Columbia U., New York, N.Y.
STRAIN ENERGY FUNCTIONS FOR FILLED ELASTOMERS
M. Shinozuka and A. M. Freudenthal Jul. 1964 36 p refs
(Contract Nonr-266 (78))
(TR-25; AD-605991)

Three different forms of the strain energy function are considered, although they can be classified into two essentially different classes. In the first case, the function is assumed to be the sum of the distortional and the volumetric strain energy, whereas in the second, it represents a possible modification of Mooney's strain energy function. For these three strain energy functions, the relations between axial and lateral deformations under uniaxial tension are plotted together with the result of experiments performed on dumbbell-shaped specimens of a KCl-filled polyurethane. The relations in uniaxial tension and compression between the axial stress and deformation are also plotted. Author

N64-33369 California U., Livermore Lawrence Radiation Lab.
SHOCK INDUCED TRANSITIONS. PART III: THEORY AND RESULTS Final Report
Marcel W. Nathans 6 Nov. 1964 42 p refs
(Proj. Gnome)
(PNE-112F, Pt. III) OTS: $2.00

Samples of the Athabasca oil sand, of the oil extracted from these oil sands, n-octane, iso-octane, 1,2-dimethylcyclohexane, and a number of rocks were subjected to shock from the Gnome event. The oil sand samples and the samples from the extracted oil were subjected to 12.5 kb shock pressure and up, resulting in a substantial molecular weight decrease, but their viscosity data were not conclusive. The yield of hydrocarbon gases increased with the shock pressure up to 5 or 6 mole percent at 40 kb. No changes were detected by chromatographic analysis of the initially extracted oil and of the oil separated from the sand after the detonation. The standard hydrocarbons showed some loss of weight leading to the conclusion that all samples had undergone cracking proportional to the high shock processes. No significant physical or chemical changes were detected in the rock samples. G.G.

N64-33463 Northrop Corp., Hawthorne, Calif. Norair Div.
ON THE INFLUENCE OF THE SIMPLY SUPPORTED BOUNDARY CONDITION ON THE STABILITY OF THIN WALLED CIRCULAR CYLINDRICAL SHELLS UNDER AXIAL LOAD AND INTERNAL PRESSURE
G. Fischer 1 Apr. 1964 32 p refs
(NOR-64-80)

Applying nonlinear shell equations, the stability behavior of a thin, simply supported cylindrical shell under axial load and internal pressure is investigated. A difference method is used for solving the system of coupled differential equations. The resulting buckling loads are below those hitherto given with the boundary conditions not fully satisfied. The results are in good agreement with experiments. Author

N64-33506 California U., Berkeley Inst. of Engineering Research
ON THE DIFFERENTIAL EQUATIONS OF THE LINEAR THEORY OF ELASTIC SHELLS
P. M. Naghdi Aug. 1964 25 p refs
(Contract Nonr-222(69))
(AM-64-15; AD-605583)

A system of basic equations of the linear banding theory of thin elastic shells, derived under the Kirchhoff–Love hypothesis, is employed. This involves symmetric shell-strain measures, symmetric stress, and couple resultants. The basic equations are rigorously reduced to a general system of fourth-order complex partial differential equations in terms of a symmetric second-order complex tensor and its conjugate. The results appear to be attractive from the point of view of application to special problems. Author

N64-33553 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
COMPARISON OF SHELL AND ELASTICITY THEORY SOLUTIONS FOR THICK, ORTHOTROPIC, CIRCULAR CYLINDRICAL SHELLS Technical Report No. 5
Jacques Crouzet-Pascal and Allan Pifko Sep. 1964 144 p refs
(Contract Nonr-3465(00) FBM)
(RE-182; AD-607217)

Basic shell equations were developed and applied to the simple axial and circumferential shear cases; the pure torsion case; the problems of an infinite orthotropic cylinder subjected to a uniform internal pressure, and of a long cylinder acted upon by peiodically spaced circumferential band loads; and a ring compressed by diametrically opposite forces. The results were compared to those of the theory of elasticity and showed that the developed shell equations can be applied to shells with a thickness to mean radius ratio (h/a) as large as 1/5, and in some instances to thicker shells. G.G.

N64-33607* Washington U., Seattle
PHOTOVISCOELASTIC EXPERIMENTS, I
Ellis Harold Dill and Charless Fowlkes Repr. from Trend Eng., v. 16, no. 3, Jul. 1964 p 5–10 refs
(Grant NsG-401)

Two experiments were performed to find out whether the stress field in a viscoelastic model can be determined by observation of the fringe order and isoclinic angle. In one test, a shear stress was applied to a thin sheet. Use of the hypothesis that the birefringence is related to the stress by a hereditary law in the form of a convolution integral showed that the stress field predicted from the observed fringe pattern agrees with the expected stress field. In the second test, the principal axes of stress are caused to rotate by first applying an axial stress and following it by a shear stress. The predicted time variation of the isoclinic angle based on the hereditary law was found to agree with the observed isoclinic angle. Author

N64-33667 Midwest Research Inst., Kansas City, Mo. Mathematics and Physics Div.
RESEARCH ON THE MECHANISMS OF FATIGUE IN ULTRA-SMALL SPECIMENS Quarterly Progress Report, 1 Apr.–30 May 1964
J. C. Grosskreutz 5 Jun. 1964 12 p refs
(Contract AF 33(657)-10883)
(QPR-3; AD-447808)

The relationship of basic mechanisms research to engineering practice is discussed. A set of experiments to determine crack nucleation time and growth rates in mildly notched specimens are described. The experimental methods are discussed in detail. Certain modifications to existing fatigue equipment are described. Author

N64-33710 Chalmers U. of Tech., Gotesborg (Sweden)
PRIMARY CREEP IN THICKWALLED SPHERICAL SHELLS
Jan Hult Scand. U. Books, 1963 30 p refs *Its* Trans. no. 264 Available from Scand. U. Books: 8 SK

The static primary creep effect is investigated for the case of a thick-walled spherical shell loaded by an instantaneously applied constant internal pressure. The material of the sphere

is assumed to be in a state of physical primary creep caused by strain hardening. Hence both types of primary creep, physical as well as static, are included in the analysis. The special case of no strain hardening can be extracted from the derived equations. D.E.W.

N64-33725 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
VIBRATION TESTING OF RESILIENT PACKAGE CUSHIONING MATERIALS
George Zell Aug. 1964 74 p refs
(TR-3160; AD-444825)

Preliminary tests have been conducted on a resilient expanded polystyrene foam (in 3 densities) and a polyether urethane foam (in one density). When vibrated under static loads known to provide optimum shock mitigation (0.6 to 1.5 psi) the polystyrene foam experienced pronounced permanent set (up to 36% of original thickness) after partial completion of the vibration transmissibility test schedule. The set induced in similar new cushions by vibration generally exceeded the set induced (under the same static loads) by 5 successive 36-inch free-fall impacts. The 5-impact sequence gave the vibrated polystyrene cushions permanent sets up to 78%. Transmitted accelerations were up to 220% of those for unvibrated cushions. Polyurethane foam subjected to the entire vibration transmissibility schedule at maximum recommended loading (0.16 psi) experienced negligible permanent set. Author

N64-33733 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
ELEMENTARY MECHANICS OF FLEXIBLE MEMBRANE STRUCTURES
F. M. Wright 11 Oct. 1963 64 p refs
(SM-45750)

Elementary structural analysis methods of inflatable expandable structures are presented. The structural behavior of membrane elements composed of both isotropic and filamentary materials under biaxial loading conditions is considered. The basic membrane theory of simple pressure vessels is reviewed and applied to the problems of concentrated loads on inflated configurations, the mechanics of pressurized membranes over rigid supports, and the behavior of various double-wall configurations. Methods of analysis of inflated structures with shear and bending loads applied are given. Author

N64-33741 Aerojet-General Corp., Sacramento, Calif.
INVESTIGATION OF FILAMENT WINDING PATTERNS Final Report
G. H. Tonn et al 15 Sep. 1964 134 p refs
(Contract NOw-63-0627-c FBM)
(Rept.-0627-I-F; AD-447368)

Structural tests were conducted on isotensoid and balanced-in-plane chambers to determine the influence of interspersed versus noninterspersed hoop and longitudinal windings on chamber performance and the influence of filament crossovers in the isotensoid winding patterns on chamber performance. On the basis of these tests, it was concluded that no observable deleterious effects on chamber performance result from the filament crossovers and that winding interspersement produces no significant difference in performance. An analytical approach to designing chamber profiles and winding patterns was developed so that appropriate head-deflection patterns can be accurately predetermined to reduce discontinuity stresses at the head-skirt cylinder junction. Author

N64-33760 Polytechnic Inst. of Brooklyn, N.Y.
FURTHER COMPARISONS OF ELASTICITY AND SHELL THEORY SOLUTIONS
Jerome M. Klosner and Howard S. Levine Jul. 1964 39 p refs
(Contract Nonr-839(17))
(PIBAL-689; AD-603853)

The problem of an infinite circular cylindrical shell subjected to periodically spaced axisymmetric band loads is investigated using a Reissner-Naghdi higher order shell theory. The generalized equilibrium equations, which include the effects of transverse normal stress and transverse shear deformation, have been applied to the specific problem at hand. These equilibrium equations were successfully uncoupled, and an expression describing the transverse displacement of the median surface was obtained. The solution of this expression was then used to calculate the stress resultants, stresses, and displacements. A comparison of the resulting stresses and displacements with the exact elasticity solution and some lower order shell theory solutions of the same problem was carried out for ratios of inner to outer shell radius equal to 0.7, 0.8, 0.87, 0.9, and 0.93, and for a ratio of distance between band loads to outer shell diameter equal to 0.2. The ratio of bandwidth to distance between band loads was also equal to 0.2. The Poisson's ratio used is equal to 0.3. Author

N64-33769* Martin Co., Denver, Colo. Aerospace Div.
INVESTIGATIONS RELATIVE TO WIND-INDUCED OSCILLATIONS OF THE SATURN BOOSTERS IN THE VERTICAL LAUNCH POSITION (1 JUNE 1963 THRU 30 JUNE 1964). PART IV: BIBLIOGRAPHY
Sep. 1964 13 p refs
(Contract NAS8-5322)
(NASA-CR-59329; CR-64-40(Pt. 4)) OTS: $1.00 fs; $0.50 mf

N64-33795 Oklahoma U. Research Inst., Norman School of Aerospace and Mechanical Engineering
VIBRATION ANALYSIS PROGRAM Final Report, Sep. 1961–Dec. 1962
John D. Ray May 1964 58 p
(Contract AF 34(601)-9593)
(AD-603141) OTS: $3.00

The objective of this program was to develop a method that could be used by technical personnel in engine field tests to reduce vibration effects encountered in jet engines. The charts that were developed are used in conjunction with the standard vibration transducer outputs during engine tests. The engine vibration problems can be determined by correlating the transducer outputs with the diagnostic charts. Three different approaches were used to get the necessary data for development of the charts: (1) engine tests with the rotating sections unbalanced; (2) static engine tests where each section was externally excited with a simulated mass unbalance; and (3) analytical approach. Author

N64-33797 Aerospace Corp., San Bernardino, Calif. Solid Mechanics Dept.
THE ELASTIC CYLINDRICAL SHELL UNDER RADIAL IMPULSE
I. K. Mc Ivor Aug. 1964 43 p refs
(Contract AF 04(695)-469)
(TDR-469(S5810-12)-1; BSD-TDR-64-117; AD-445145)

In the motion of an elastic cylindrical shell following impulsive pressure, marked deviations from linear theory may occur through interaction of circumferential membrane

force with flexural curvature. Energy is transferred to flexural modes of rather high order. The resulting flexural stress is significantly higher than that given by linear theory. Author

N64-33891* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDIES OF TOUCHDOWN STABILITY FOR LUNAR LANDING VEHICLES
W. C. Walton, Jr., R. W. Herr, and H. W. Leonard Repr. from J. Spacecraft and Rockets, v. 1, no. 5, Sep.–Oct. 1964 p 552–556 refs Presented at the AIAA Aerospace Sci. Meeting, N.Y., 20–22 Jan. 1964, revised 4 May 1964
(NASA-RP-350; AIAA Paper-64-94)

The paper presents early results of a study to establish practical procedures for predicting tumbling histories for a vehicle that impacts on a nonlevel surface. Symmetrical and asymmetrical inelastic impacts are discussed. Under the symmetrical case the main points of the simple theory are restated; critical modes of overturning for a four-legged body are identified and computed, and experimental landing stability boundaries for a four-legged rigid model are correlated. Computed boundaries for two rigid configurations representative of current thinking about lunar landing vehicles are compared. Under asymmetrical impact there is a correlation of stability boundaries obtained by experiment and by digital simulation for the four-legged rigid model landing on a slope with vertical velocity only. Author

N64-33910 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ENERGY DISSIPATION AT STRUCTURAL JOINTS; MECHANISMS AND MAGNITUDES Technical Documentary Report, Dec. 1962–Apr. 1964
Eric E. Ungar Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Aug. 1964 142 p refs *Its* Rept.-1137
(Contract AF 33(657)-10125)
(FDL-TDR-64-98; AD-607257)

A largely experimental study is described, which indicates that dissipation of vibratory energy at multipoint-fastened (bolted, riveted, spot-welded) joints connecting panels to stiffeners or to other panels, at frequencies considerably above the panel fundamental, is primarily due to the "pumping" of air produced as adjacent surfaces between fasteners move away from and toward each other. Heckl's absorption coefficient concept is shown to apply to these joint types, and it is demonstrated that the joint absorption coefficient is a function of the ratio of fastener spacing to plate flexural wavelength. Based on these findings and on empirical data, an approach is developed for estimating the damping of panels with joints. A study of the energy dissipation characteristics of plate strips whose ends are bolted to rigid supporting structures is discussed. Author

N64-33911 Southampton U. (Gt. Brit.)
THE OPTIMUM USE OF UNCONSTRAINED LAYER DAMPING TREATMENTS Technical Documentary Report, Jan. 1961–Jan. 1962
D. J. Mead and T. G. Pearce Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1964 61 p refs
(Contract AF 61(052)-504)
(ML-TDR-64-51; AD-607244)

Since unconstrained layer damping treatments on vibrating plates dissipate energy by undergoing bending strain, the treatment in the vicinity of lines of contraflexure contributes little to the total damping. This report investigates the effect of concentrating the treatment in the regions of highest bending moment in order to use all the material more effectively. Three methods of analysis are presented, two of them being approximate but relatively rapid in use. The third has been used in extensive digital computer calculations to determine the effectiveness of given quantities of treatment, having given stiffness, when distributed over different proportions of the length of a vibrating, simply supported strip. The effectiveness has been assessed using certain criteria that apply to different problems, e.g., to the problems of reducing harmonic resonant vibration amplitudes, or inertia forces exerted by randomly vibrating panels, etc. Very considerable increases of effectiveness are obtained by concentrating the treatment over a proportion of the length or area. Author

N64-33982 Stanford U., Calif.
CREEP RUPTURE OF DUCTILE MATERIALS SUBJECTED TO STRAIN HARDENING OR TIME HARDENING CREEP
Josef Singer Jun. 1964 29 p refs
(Contract Nonr-225(47))
(SUDAER-196; AD-444808)

An analysis of creep rupture of ductile materials subjected to strain hardening creep is presented. The analysis is similar to an earlier one by Hoff, but is based on a different generalization of the primary creep rate relation. Both approaches are then extended to time hardening creep. Simple approximate formulas for critical times are presented, and the results of both approaches for the two types of creep are compared. Correlation with experimental data for some aluminum–copper, aluminum–magnesium, and aluminum–zinc alloys shows fairly good agreement of rupture times for these very ductile materials. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-33640 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
CONCEPTS AND APPLICATIONS OF EXPANDABLE STRUCTURES
F. M. Wright 1 May 1963 85 p refs
(SM-42809)

The general nature and definition of expandable structures is presented along with general advantages and disadvantages. The different expandable concepts currently being considered for application to aerospace structures are described. The current state-of-the-art of each of these concepts is outlined, and their advantages and disadvantages relative to each other are indicated. Possible applications of expandable structures to the various areas of aerospace structures are presented. Author

N64-33665 Bell Aerosystems Co., Buffalo, N.Y.
SELECTION TECHNIQUES FOR BRITTLE MATERIALS (EVALUATION OF ZrB_2-$MoSi_2$ AS A STRUCTURAL REFRACTORY CERAMIC BODY)

Frank M. Anthony and W. H. Dukes Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 52 p refs
(Contract AF 33(657)-11284)
(Rept.-2178-900204; AD-448614)

Scaleup activities began on the final leading-edge segment design. Material property data generation was initiated. Bend tests of small bars at room temperature, 2000° F, and 2800° F, as well as thermal expansion measurements were completed. Bending proof tests and thermal conductivity tests were initiated. Design of the final leading-edge configuration was completed. Author

N64-33858 Forest Products Lab., Madison, Wis.
STRUCTURAL SANDWICH DESIGN CRITERIA
Edward William Kuenzi Oct. 1959 17 p refs Reprinted 1963 Presented at the 1959 Fall Conf. of the Building Res. Inst., Wash., D.C., 17–19 Nov. 1959
(FPL-2161)

Design criteria are presented for structural sandwich constructions under various types of loading. Included are a brief historical background, a discussion of what constitutes a structural sandwich construction, and basic design philosophy. Detailed design procedures are presented for determining deflections of sandwich beams or panels and buckling of sandwich columns and simply supported panels under edge load, including formulas for calculating facing stresses and core shear stresses. Formulas presented are general and can be applied to a wide range of materials if properties of the materials are known. Methods of test for evaluating certain material properties are discussed briefly. Modes of failure of sandwich under various loadings are illustrated. Author

N64-33903* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE DEVELOPMENT OF METAL HONEYCOMB ENERGY-ABSORBING ELEMENTS
R. K. Mc Farland, Jr. 24 Jul. 1964 35 p refs
(Contract NAS7-100)
(NASA-CR-59371; JPL-TR-32-639) OTS: $2.00 fs; $0.50 mf

The results of an experimental development program to evaluate and optimize metal honeycomb elements for use as axial energy absorbers are presented. The results indicate the potential of metal honeycomb elements for this purpose, and the range of variables to be considered in the design and optimization of these elements. Author

N64-33939 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPLICATION OF THE METHOD OF CONSECUTIVE APPROXIMATIONS IN THE DESIGN OF RIBBED SHELLS
V. M. Ryabov 21 Sep. 1964 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, OTD. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1963 p 150–154
(FTD-TT-64-418/1+2+4; AD-607115)

This article describes a method for improving the solution for a structurally orthotropic shell by means of consecutive approximations taking into account local stresses in the facing, together with an evaluation of the error in determining the basic stresses in the original scheme of the anisotropic shell. The entire discussion is directed toward a circular cylindrical shell reinforced along the lines of major curvature, but in principle it may be extended to shells of more complex form, e.g., to cylindrical shells reinforced along lines of major curvature or to shells having the shape of surfaces of revolution. Author

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